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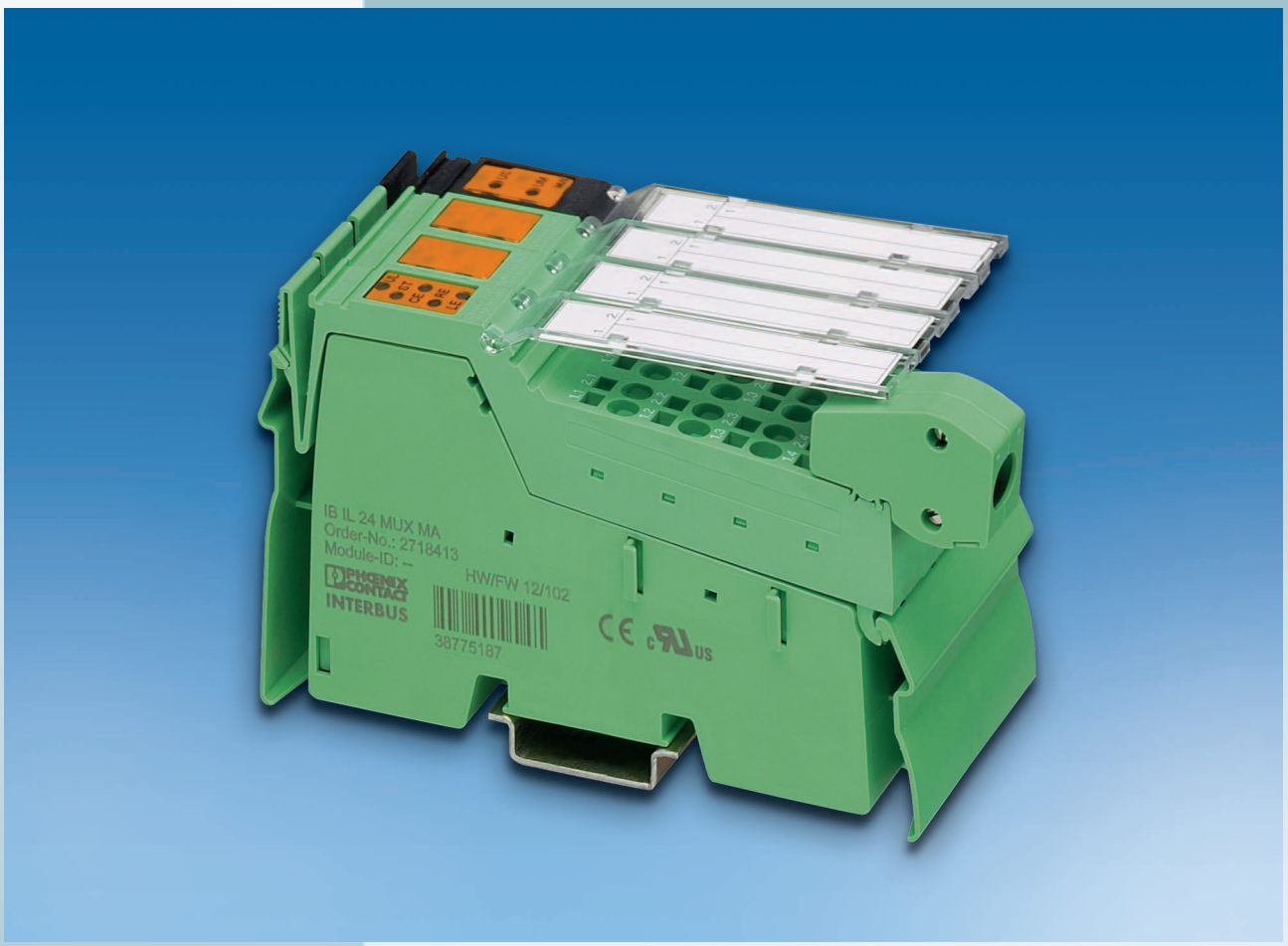

User Manual

IB IL MUX UM E

Order No.: —

Configuring and installing the
Inline field multiplexer

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AUTOMATION

User manual

Configuring and installing the Inline field multiplexer

11/2008

Designation: IB IL MUX UM E

Revision: 02

Order No.: —

This user manual is valid for:

Designation	Order No.
IB IL MUX MA-PAC	2861205
IB IL MUX MA	2818413
Associated system components	

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In order to ensure the safe use of the product described, you have to read and understand this manual. The following notes provide information on how to use this manual.

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This indicates a hazardous situation which, if not avoided, could result in death or serious injury.

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This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

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1 Information about this document and the documentation landscape for Inline Modular IO

1.1 Function of this user manual

At the beginning, this user manual describes the IB IL MUX MA (-PAC) field multiplexer. This manual also helps you from configuration and installation to start up and function test of a field multiplexer system.

1.2 The documentation landscape for Inline Modular IO in reference to the field multiplexer

The documentation for Inline Modular IO is modular, providing you with the optimum information for your specific application with your Inline terminals used.

The documentation can be downloaded at www.download.phoenixcontact.com.

For a comprehensive list of the documentation, please refer to the ordering data (see Section "Ordering data" on page 10-6).

Terminal-specific documentation can be found in the download area for the corresponding device.

Make sure you always use the latest documentation.

The following documentation is available for the field multiplexer in association with Inline Modular IO:

IL SYS INST UM E **"Automation terminals of the Inline product range" user manual**

This manual is the generic system manual for Inline and describes the use of terminals/modules in the Inline product range for all bus systems.

The following topics are covered:

- The device properties, which are the same for all bus systems
- Notes on the low voltage area
- Overview of the Inline product groups
- Structure and dimensions of Inline terminals
- Electrical potential and data routing
- Mounting and removing
- General technical data and ordering data
- Examples and tips

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Data sheets

Terminal-specific data sheets

The data sheet describes the specific properties of each Inline terminal.
These include at the very least:

- Function description
- Local diagnostic and status indicators
- Pin assignment/terminal point assignment and connection example
- Programming data/configuration data
- Technical data

"Summary of key data for Inline devices" data sheet, DB GB IB IL DEVICE LIST

This data sheet is also referred to as the device list.

In addition to terminal-specific data sheets, this data sheet also includes the key data of every Inline Modular IO device. This includes, for example:

- Programming data: ID code, length code, process data channel, I/O address area
- Error messages
- Power supply/current consumption

Application notes

Application notes provide additional information about special topics.
In conjunction with the field multiplexer, these include, for example:

– I/O modules at bus couplers	AH BK IO LIST
– General information about use in Ex zone 2 potentially explosive areas	AH EN IL EX ZONE 2

Device-specific application notes are listed in the device-specific data sheet and are available in the download area for the relevant device.

Package slips

A package slip contains key information for the electrical installation of an Inline terminal or group of Inline terminals. This includes, for example:

- Short description
- Safety notes
- Assembly/removal
- Terminal point assignment
- Local diagnostic and status indicators

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2 Notes on using the terminal in potentially explosive areas

Approval according to directive 94/9/EC

Ⓔx II 3 G Ex nAC IIC T4 X

Installation notes

1. This Inline terminal can be installed in zone 2.
2. The Inline terminal must only be installed, operated, and maintained by qualified personnel.
3. Please follow the installation instructions given in the IL SYS INST UM E user manual and the package slip.
4. Observe all applicable safety directives (even national safety regulations), accident prevention regulations, as well as general rules of technology when installing and operating the equipment.
5. Please refer to the corresponding documentation (user manual, data sheet, package slip) and the certificates (EC type examination and other approvals, if applicable) for safety-related data.
6. It is not permitted to access the circuits inside the Inline terminal. Do not repair the Inline terminal by yourself but replace it with a terminal of the same type. Repairs may only be carried out by the manufacturer.
7. IP20 (EN 60529) protection of the device is provided for a clean and dry environment.
8. Do not subject the Inline terminal to mechanical strain and thermal loads, which exceed the limits specified in the product documentation.
9. The Inline terminal has not been designed for use in dust potentially explosive atmospheres.

Installation in zone 2

1. Observe the specified conditions for use in potentially explosive areas.
2. When installing the terminal, use an appropriate and approved housing with a minimum protection of IP54. Please observe the EN 60079-14 requirements, e.g., a steel housing with a wall thickness of 3 mm.
3. In potentially explosive areas, only snap the Inline terminal onto the rail and connect the cables when the power is switched off.
4. In zone 2, only connect devices to the supply and signal circuits that are suitable for operation in potentially explosive areas of zone 2 and the conditions at the installation location.

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Restrictions/limit values

1. **Only Inline terminals that are approved for use in potentially explosive areas may be snapped next to this Inline terminal.**
   Before using an Inline terminal in a zone 2 potentially explosive area, first check that the terminal has been approved for installation in this area.

   For a list of terminals approved for use in zone 2 potentially explosive areas, please refer to the AH EN IL EX ZONE 2 application note.
2. Please ensure that the **supplies of U_M and U_S** at the field multiplexer do not exceed **4 A**.
3. Please make sure that the **maximum permissible current of 4 A** flowing through potential jumpers U_M and U_S (total current) is not exceeded when using the Inline terminals in potentially explosive areas.
4. Also ensure that the **maximum permissible current of 2 A** flowing through potential jumper U_L is not exceeded.
5. The maximum permissible current for each tension spring contact is 2 A.

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3 Using a field multiplexer in the field multiplexer system

The field multiplexer is a simple system for the transmission of signals between remote stations. It has a modular design, and saves on conventional parallel cabling.

A field multiplexer system is set up using two **identical** field multiplexers. The multiplexers are electrically linked over a 2-wire cable and may transmit digital and analog signals over a distance of up to 12 km.

Data can also be transmitted over fiber optics, telephone lines, Bluetooth or Ethernet. In these cases other maximum distances are possible (see Section "Transmission media" on page 7-1).

3.1 Arrangement of a field multiplexer system

The field multiplexer and the Inline I/O terminals connected to it form a station. A field multiplexer system consists of two stations. The two stations must be arranged in such a way that each input terminal is assigned to an output terminal on the other side, and vice versa (complementary arrangement, see Figure 3-1).

In addition to the complementary arrangement of I/O terminals in each station and its counterpart, a distinction must be made between the active (master) and the passive (slave) field multiplexer station. This is done by inserting a jumper into one of the stations, which thereby becomes the master. Further configuration settings are not required.

Up to 63 Inline I/O terminals can be connected to a field multiplexer station simply by mounting them next to one another.

The intelligent wiring method used by Inline terminals enables the field multiplexer station to be created quickly and easily, since, for example, time-consuming wiring of the terminal power supply is not required. It is only necessary for the power supply units integrated in the field multiplexers to be supplied with 24 V DC on the input side. They generate the operating voltage required for the field multiplexer **and** the connected Inline I/O terminals.

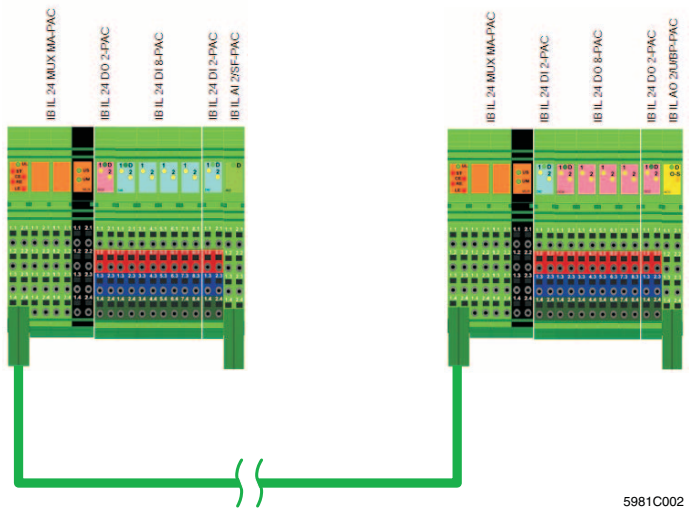
IB IL 24 MUX MA-PAC
IB IL 24 DO 2-PAC
IB IL 24 DI 8-PAC
IB IL 24 DI 2-PAC
IB IL AI 2/SF-PAC
IB IL 24 MUX MA-PAC
IB IL 24 DI 2-PAC
IB IL 24 DO 8-PAC
IB IL 24 DO 2-PAC
IB IL AO 2/UBP-PAC
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Figure 3-1 Complementary arrangement of I/O terminals

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3.2 Data transmission

A maximum of 512 I/O data can be transmitted by each station. This corresponds to a maximum of 512 digital or 32 analog inputs and/or outputs. Digital and analog signals may also be mixed.

The transmission time for all I/O data depends on the number of inputs and outputs to be transmitted, but is a maximum of 1 s. In practice, data is transmitted considerably faster (see also "ransmission time" on page 3-3).

The field multiplexer transmits the signals that are present in parallel at the I/O terminals serially along the cable. At the other end of the cable, the signals are output again through the complementary I/O terminals in the opposite station.

Data is transmitted between two field multiplexer stations over a 2-wire copper cable. RS-485 transmission reduces the effect of electromagnetic interference on the signals. A maximum distance of 12 km may be covered.

The maximum distance depends on the type of cable selected, as well as on EMC environmental conditions.

Data can also be transmitted over fiber optics, telephone lines, Bluetooth or Ethernet. In this case, use additional interface converters from Phoenix Contact and configure the field multiplexers and converters accordingly (see Section "Technical appendix: The field multiplexer with different transmission media" on page A-1).
fiber-optic transmission is configured using a jumper on the first Inline connector.

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3.3 Transmission time

The maximum time required for data transmission depends on the type of transmission medium that has been selected, and can be calculated using the formula below.

Only the I/O terminals from one of the two stations have to be taken into consideration when making the calculation.

When operating field multiplexer systems over copper cables, the following formula applies

$$t_{up} = n * 6.8 \text{ ms/byte} + 78 \text{ ms} + m$$

t_{up} = Update time for field multiplexer I/O data
n = Number of bytes to be transmitted (n = 1 ... 64 bytes)
m = Delay when using different transmission media

Copper	m = 0 ms
Telephone line	m = 20 ms
Ethernet cable	m = 0 ms
Bluetooth connection	m = 40 ms

If the field multiplexer is operated over fiber optics, this formula applies

$$t_{up} = n * 1.37 \text{ ms/byte} + 10 \text{ ms}$$

Both formulas are valid for worst case scenarios. Transmission is usually faster.

The number of bytes to be transmitted depends on the particular terminal:

Type of terminal	n [in bytes]
Digital terminal with 2, 4, or 8 channels	1
Digital terminal with 16 channels	2
Digital terminal with 32 channels	4
Analog terminal with 1 channel	2
Analog terminal with 2 channels	4

The transmission time typically varies within the following limits:

t_{up} (copper): 80 ms ... 500 ms
t_{up} (fiber optic): 10 ms ... 100 ms

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3.4 Diagnostics

LEDs provide station diagnostics on the field multiplexer and the Inline I/O terminals. An integrated alarm relay permits alarms or warning lamps to be connected locally.

3.5 Additional system components

The field multiplexer system is completed by additional system components from the Phoenix Contact product range (see Section "Accessories: Additional system components" on page 10-6).

3.6 Number of devices in a field multiplexer station

The maximum number of devices that can be connected to a field multiplexer is determined by the following system specifications:

1. Up to 63 devices can be connected to a field multiplexer.
2. A maximum of 512 digital or 32 analog signals can be transmitted (even mixed; each analog channel is treated like a 16-bit digital terminal).
3. The field multiplexer can supply a maximum current of 2 A at 7.5 V DC in the logic area.
4. The field multiplexer can supply a maximum current of 0.5 A at 24 V DC to analog terminals.
5. The maximum current for the I/O supply is 8 A at U_S, U_M and GND (total current U_S + U_M).

Please refer to the IL SYS INST UM E user manual for detailed information on the individual circuits within an Inline station, which also apply for a field multiplexer station.

NOTE: Overload in the event of configuration errors

Observe the current consumption of each device at the individual potential jumpers when configuring an field multiplexer station. It can be found in every terminal-specific data sheet as well as in the DB GB IB IL DEVICE LIST data sheet.

To determine the maximum number of terminals, add up the current consumption of the connected I/O terminals.

If the limit value is reached at one of the potential jumpers, a new appropriate power terminal must be used.

NOTE: Malfunction or overload in the event of configuration errors

The permissible number of devices that can be connected depends on the specific station arrangement. None of the system specifications given above must be exceeded.

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4 Description of the field multiplexer

The IB IL MUX and IB IL MUX MA-PAC only differ in the scope of supply (see "Ordering data" on page 10-6). Their function and technical data are identical. For greater clarity, the order designation IB IL MUX MA-PAC is used throughout this document.

4.1 General description

Functions

The field multiplexer

- forms the head of an field multiplexer station. All the necessary Inline I/O terminals are connected to it.
- configures the station and manages data exchange with the opposite station over a remote bus cable.
- supplies power to the connected I/O terminals.
  The field multiplexer generates the logic voltage U_L for all connected devices from the supplied supply voltage U_{MUX} as well as the supply voltage U_{ANA} for the connected analog terminals.

Please refer to the IL SYS INST UM E user manual for information on the individual circuits within an Inline station, which also apply for a field multiplexer station.

Indicators

See Section "Diagnostic indicators" on page 4-3.

Connections

See Section "Terminal point assignment" on page 4-4.

Connection method

The field multiplexer is suitable for the connection of copper cables.

Connect cables with diameters of 0.08 mm^2 through 1.5 mm^2 (AWG 24 - 16) to the spring-clamp connections of the Inline connectors.

In order to implement data transmission over other transmission media, additional interface converters from Phoenix Contact must be used (see Section "Transmission media" on page 7-1 or Section "Technical appendix: The field multiplexer with different transmission media" on page A-1).

Protection

The field multiplexer has protection against polarity reversal and excess voltage on U_{MUX}.

Potential and data routing

The potential and data routing of the field multiplexer station begins at the field multiplexer.

Please refer to the IL SYS INST UM E user manual for detailed information on the individual jumpers as well as on the maximum capacity of the jumper contacts.

Connection to functional earth ground (FE)

If the remote bus cable is shielded, the shield is internally connected through a capacitor to FE.

In the terminal, there is a capacitive connection of U_{MUX}, U_M, U_S, and GND to FE.

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Grounding

The field multiplexer is grounded when it is snapped onto the grounded DIN rail via the FE spring on the bottom of the terminal. This spring is connected to the potential jumper FE and to the terminal points for an FE connection (see "Required additional grounding").

Required additional grounding

Ground the field multiplexer additionally through the FE connection to ensure reliable grounding of the station even if the FE spring is dirty or damaged. Connect the terminal points for the FE connection to a grounded PE terminal.

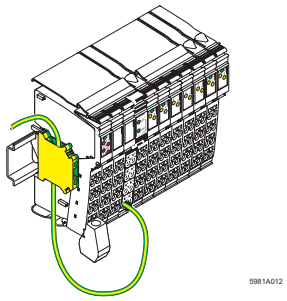

Figure 4-1 Additional grounding of the field multiplexer

Please refer to the IL SYS INST UM E user manual for information on the grounding concept.

Electrical isolation

Notes on the various voltage ranges in the field multiplexer can be found in Section 5.2.2 "Electrical isolation".

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4.2 Diagnostic indicators

Diagnostic indicators are used for local error diagnostics.

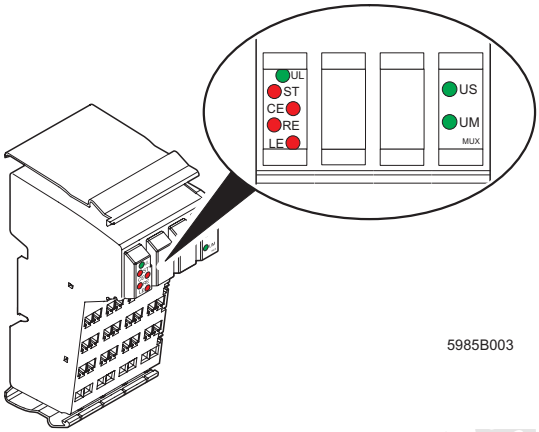

Figure 4-2 Diagnostic indicators

Table 4-1 Diagnostic LEDs on the field multiplexer

LED	Color	Meaning	Status	Description of the LED states
UL	Green	U_{Logic}	On	24 V field multiplexer supply (U_{MUX}), 7.5 V main supply U_L and interface supply present
			Flashing	Hardware faulty and/or interface supply not present
			Off	Supply voltage not present
ST	Red	**St**op	On	Field multiplexer in stop
			Off	Field multiplexer system operating
CE	Red	**C**onfiguration **E**rror	On	Configuration error
			Off	Configuration of both field multiplexers is OK
RE	Red	**R**emote bus **E**rror	On	Error on remote bus
			Flashing	Software versions of the two field multiplexers are not identical
			Off	Communication between the field multiplexers functioning correctly
LE	Red	**L**ocal Bus **E**rror	On	Error on the local bus of this field multiplexer station (e.g., a faulty I/O terminal)
			Flashing	Error on the local bus of the opposite station
			Off	Local bus OK
US	Green	$U_{Segment}$	On	24 V segment circuit supply present
			Off	24 V segment circuit supply not present
UM	Green	U_{Main}	On	24 V main circuit supply present
			Off	24 V main circuit supply present

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4.3 Terminal point assignment

The field multiplexer is delivered with connectors and labeling fields. To connect the cables to the IB IL MUX terminal you need the IB IL MUX-PLSET connector set, Order No. 2836036.

Connector 1
- Remote bus connection
- Configuration of transmission mode

Connector 2
- No function

Connector 3
- Floating alarm contact
- Configuration of master/slave setting
- Field multiplexer supply U_{MUX} that generates the communications power U_L and the supply for the analog terminals U_{ANA}.

Connector 4
- Voltage supply for the segment (U_S) and the main circuit (U_M)

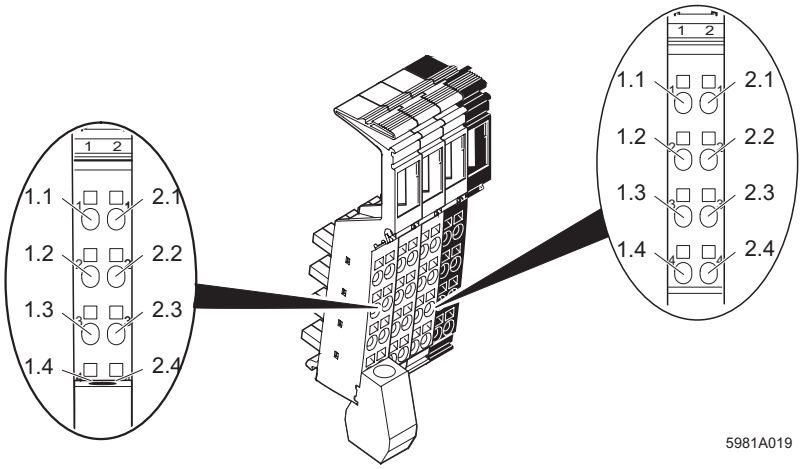

Figure 4-3 Terminal point assignment

Table 4-2 Terminal point assignment

Terminal point	Assignment	Remark
Connector 1	**Remote bus, configuration of transmission mode (copper/fiber optics)**	
1.1, 2.1	$CONF_{FO}$	Configuration of transmission mode (copper/fiber optics)
1.2	DATA	Differential signal, data line to the opposite station (remote bus)
2.2	$\overline{DATA}$	Differential signal, data line to the opposite station (remote bus)
1.3, 2.3	GND_{DATA}	Reference potential for DATA and $\overline{DATA}$
1.4, 2.4	Shield	Shield potential of the data line (remote bus)
Connector 2	**No function**	
		Cover for unused terminal points

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Table 4-2 Terminal point assignment

Terminal point	Assignment	Remark
Connector 3	**Floating alarm contact, field multiplexer supply (U_{MUX}), master/slave configuration**	
1.1	Alarm_IN	Alarm contact (floating, closed in the event of an error)
2.1	Alarm_OUT	Alarm contact (floating, closed in the event of an error)
1.2, 2.2	U_{MUX}	field multiplexer supply (24 V DC)
1.3, 2.3	GND_{MUX}	GND for field multiplexer supply The potential is reference ground for the field multiplexer electronics
1.4, 2.4	$CONF_{MA}$	Master/slave configuration
Connector 4	**Power connector for main and segment supply (U_M / U_S)**	
1.1, 2.1	U_S	24 V segment supply The supplied voltage is directly routed to the potential jumper.
1.2, 2.2	U_M	24 V main supply The supplied voltage is directly routed to the potential jumper.
1.3, 2.3	GND	The reference potential is directly led to the potential jumper and is, at the same time, reference ground for the main and segment supply.
1.4, 2.4	FE	Connection of the field multiplexer, i.e., of the field multiplexer station to functional earth ground. The contacts are directly connected to the potential jumper and the FE spring on the bottom of the housing. Functional earth ground is only used to discharge interference.

For information on the power supplies, please refer to the IL SYS INST UM E user manual.

NOTE: Overload

The maximum permissible total current flowing through the potential jumpers U_M and U_S is 8 A.

NOTE: Malfunction

Connect the field multiplexer to functional earth ground via the FE connection of connector 4. For this, connect the corresponding contact with a grounding terminal (see also Figure 4-6 on page 4-8).

The following terminal points are jumpered internally in the module:

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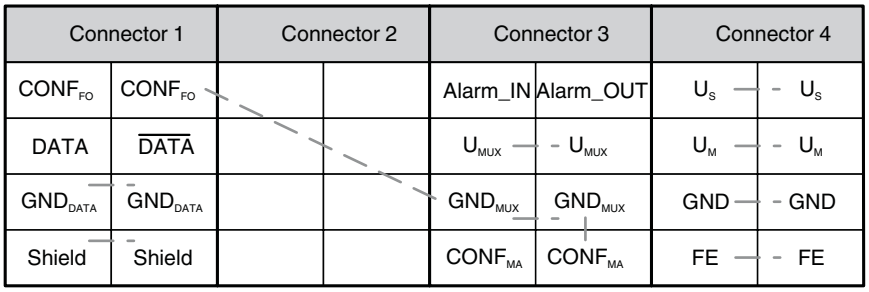

Figure 4-4 Internal jumpering

4.4 Installation instructions

4.4.1 Transmission media in the field multiplexer system

When you use an additional interface converter, you may use different transmission media within the field multiplexer system. They are described in detail in Section "Transmission media" on page 7-1.

4.4.2 Supply from a single power source

If a field multiplexer station is to be supplied from a shared 24 V DC supply (U_{MUX}, U_S and U_M), three cable jumpers must be inserted for this purpose (Figure 8-3 on page 8-12).

NOTE:
In this case there is **no** electrical isolation between U_{MUX} and U_S / U_M.

4.4.3 Alarm contact

The field multiplexer has **a floating** alarm output (Alarm_IN and Alarm_OUT contacts at connector 3, see Figure 4-6 on page 4-8) that allows to indicate operating errors remotely. The contact is normally open, but it is closed in the event of an error and when the field multiplexer power supply fails.

Notes on the current carrying capacity of the alarm contacts can be found in the technical data in the Appendix.

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4.4.4 Temperature measurements

Temperatures can be measured in the field multiplexer system using MCR temperature measuring transducers from Phoenix Contact. They are connected in front of analog input terminals (see Figure 4-5).

Make sure that the same transmission mode (copper) is always set for both field multiplexers.

You will find MCR temperature measuring transducers that can be used in the field multiplexer system in Section "Ordering data" on page 10-6. PT 100 and thermocouple sensors can be connected to these types.

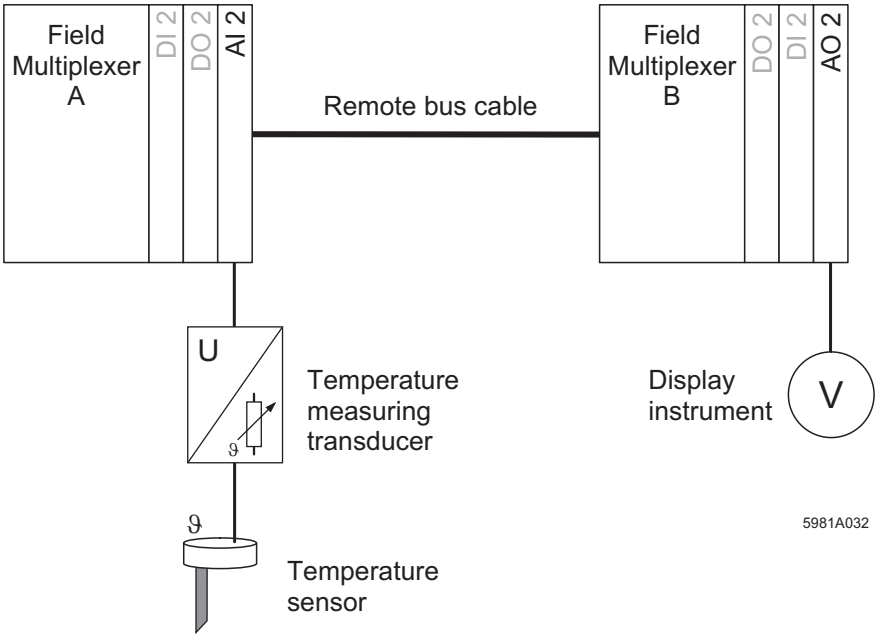

Figure 4-5 Circuit diagram “Temperature measurement”

Information on the configuration and connection of temperature measuring transducers can be found in the corresponding documentation.

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4.5 Configuration

The field multiplexer does not require any configuration software. It is configured with cable jumpers on the connectors.

4.5.1 Configuring the "fiber optics (FO)" transmission mode

If you want to implement fiber optic data transmission, insert a cable jumper at connector 1 from 1.1 to 2.1 ($CONF_{FO}$) (see Figure 4-6 on page 4-8).

NOTE: Malfunction

Ensure that the same transmission mode (copper/fiber optics) is always set on the field multiplexer station and the opposite station.

Set the required fiber optic converters to a transmission rate of 75 kbaud and a character length of 11 bits (see also Section "Transmission over fiber optics" on page A-3).

4.5.2 Configuring the station as a master or a slave

One field multiplexer station **must** be configured as the master. To do this, insert a cable jumper at connector 3 from 1.4 to 2.4 ($CONF_{MA}$) (see Figure 4-6 on page 4-8).

The **second** station **must** be configured as a slave. It must not have a wire jumper at connector 3 from 1.4 to 2.4.

4.6 Connection example

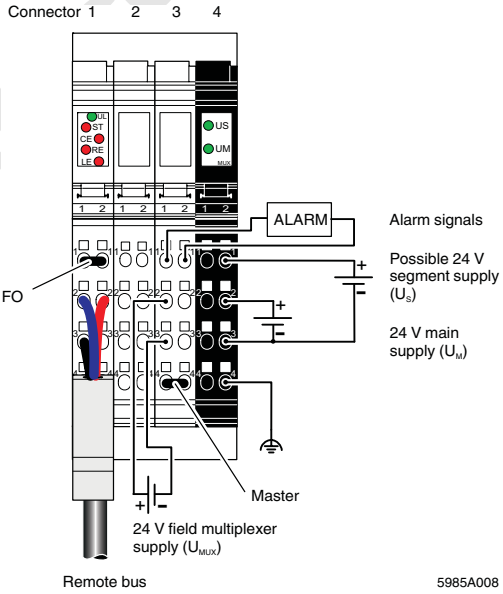

Figure 4-6 Typical connection of the cables to the field multiplexer

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4.7 Installing and removing the field multiplexer station

WARNING: Hazardous contact voltage
Before installing or removing the station, make absolutely sure that the power supply is switched off and cannot be switched on again by unauthorized persons.

Unpacking the field multiplexer

The field multiplexer is supplied in an ESD bag together with a package slip with installation instructions. Please read the complete package slip carefully before unpacking the field multiplexer.

NOTE: Electrostatic discharge
The terminal contains components that can be damaged or destroyed by electrostatic discharge. When handling the terminal, observe the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and EN 61340-5-2.

Generic documentation

Please refer to the IL SYS INST UM E user manual for information on how to install and remove the field multiplexer and the connected Inline terminals.

Installation without tools

A field multiplexer station is set up by mounting the individual components side by side. No tools are required. Mounting the components side by side automatically creates potential and bus signal connections between the individual station components.

Mounting location

As all other terminals of the Inline product range the field multiplexer has IP20 protection and is designed for use in a closed control cabinet or control box (terminal box) with IP54 protection or higher.

DIN rail

The field multiplexer station is mounted on a 35 mm standard DIN rail. The station is mounted perpendicular to the DIN rail.

End clamp

Mount end clamps on both sides of the field multiplexer station. They ensure that the field multiplexer station is correctly mounted. End clamps fix the station on both sides and keep it from moving from side to side on the DIN rail. Phoenix Contact recommends using CLIPFIX 35-5 end clamps (Order No. 3022276).

End plate

The mechanical end of an field multiplexer station is the end plate. It has no electrical function. It protects the station against ESD pulses and the user against dangerous contact voltages. The end plate is supplied with the field multiplexer and does not have to be ordered separately.

Mounting position

Install the field multiplexer station in a horizontal or vertical position.

Assembly/removal/ replacement

To do this, proceed as described in the IL SYS INST UM E user manual.

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Shielding

Shielding is used to reduce the effects of interference on the system. In the Inline system, remote bus cables and the cables to connect terminals for analog signals are shielded.

Observe the following points when installing shielding:

- Connect the shielding via the shield connector. Fasten the shielding so that as much of the braided shield as possible is held underneath the clamp of the shield connection.
- Make sure there is good contact between the connector and base.
- Do not damage or squeeze the wires. Do not strip more than 8 mm off the wires.
- Always connect analog sensors and actuators with shielded, twisted pair cables.

Connecting the remote bus cable

The remote bus cable is shielded. It is connected using the shield connector.

Please refer to Section "Terminal point assignment" on page 4-4 for the assignment of the terminal points.

In order to improve noise immunity, Phoenix Contact recommends a 3-wire, shielded cable.

Connecting sensors and actuators

Sensors and actuators are connected using the Inline connectors. Each terminal-specific data sheet indicates which connector(s) can be used for which terminal.

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4.8 Terminals approved for use on the field multiplexer

4.8.1 Universal terminals that can be used on the field multiplexer

Supply terminals

Power terminals and segment terminals are available to supply the station with I/O voltage. Different types can be used to meet your requirements:

- Basic power/segment terminal
- Power or segment terminal with integrated thermal or electronic fuse protection
- Power terminals for different voltage levels

NOTE: Consequential damage

Protect the power supply externally, regardless of the power and/or segment terminal used.

By connecting U_{MUX}, U_S and U_M in parallel, the entire station can be supplied by one power supply. Supply terminals are then not required.

I/O terminals

You may use Inline terminals for analog and digital signals on the field multiplexer.

Function terminals from the Inline product range (e.g., temperature sensors, counters, or absolute encoder modules) are not permitted on the field multiplexer.

A basic description of the terminals can be found in the IL SYS INST UM E. For additional information, please refer to the terminal-specific documentation.

4.8.2 Terminals that can actually be used on the field multiplexer

The AH IL BK IO LIST application note lists all I/O terminals that can be used on the field multiplexer.

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5 Power supplies and voltage concept

5.1 Power supplies

To operate a field multiplexer station you must provide the supply voltage for the field multiplexer, for the logic of the terminals and for the sensors and actuators.

The power supplies are connected using unshielded cables.

Please refer to Figure 4-3 on page 4-4 for the connector assignment in order to connect the power supplies to the field multiplexer.

If you use additional power or segment terminals, please refer to the terminal-specific data sheets for the connector assignment.

WARNING:

Before removing a terminal from or inserting a terminal in the station, disconnect the power to the entire station. Make sure the entire station is reassembled before switching the power back on.

5.1.1 Supply at the field multiplexer

In the simplest case, the required 24 V supply voltages can be supplied at the field multiplexer. The entire station is supplied with power from the field multiplexer.

In this case you must provide the following supply voltages:

U_{MUX}

24 V field multiplexer supply

The following voltages are generated from the field multiplexer supply:

– Internal communications power of the field multiplexer
– Communications power for the field multiplexer station I/O terminals, supplied through potential jumpers U_L;
– Analog terminal supply provided through the potential jumper U_{ANA}.

If the U_{MUX} power supply is switched off, the bus stops since the U_L communication power fails as well.

U_M

24 V main circuit supply

The main voltage U_M supplies all of the devices connected to the main circuit.

U_S

24 V segment circuit supply

The segment voltage U_S can be supplied separately to the field multiplexer or tapped from the main circuit. Install a jumper or create a segment circuit using a switch to tap the voltage U_S from the main circuit U_M.

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The voltage U_S supplies all of the devices connected to the segment circuit.

The supply voltage to the sensors and actuators (U_M/U_S) should be installed and protected independently of the field multiplexer supply (U_{MUX}). In this way the bus continues to run even if some I/O devices are switched off.

Electrical isolation

If electrical isolation is required between logic and I/O you must provide the field multiplexer supply U_{MUX} and the I/O supply U_M/U_S from separate power supplies.

Please refer to the information in Section "Electrical isolation" on page 5-4 and in Section "Connecting and configuring the field multiplexer" on page 8-11.

5.1.2 Providing/supplying power at power and/or segment terminals

In addition to supplying power for the I/Os on the field multiplexer you may also provide/supply the voltages U_M and/or U_S with power and/or segment terminals.

For detailed information on these terminals, please refer to the IL SYS INST UM E user manual or the terminal-specific data sheets.

5.1.3 Demands on the voltage supplies

WARNING: Hazardous contact voltage
Only use power supplies that ensure safe isolation between the primary and secondary circuits according to EN 50178.

For additional voltage supply requirements, please refer to the data sheets for the power terminals.

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5.2 Voltage concept within an field multiplexer station

5.2.1 Power and segment terminals

Please refer to the IL SYS INST UM E user manual for detailed information on the voltage concept within an Inline station, which also applies for a field multiplexer station.

Power terminal

The power terminal interrupts the potential jumpers for the main circuit U_M, the segment circuit U_S, and the reference potential GND. To do this, the voltages are to be recreated.

This principle is shown schematically in Figure 5-1 for a section of a field multiplexer station.

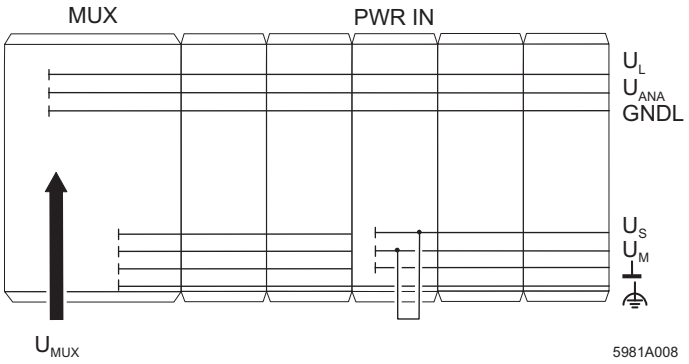

Figure 5-1 Example: Interruption/recreation of the potential jumpers through the power terminal

Segment terminal

The segment terminal interrupts the potential jumper U_S of the previous terminal an recreates it (segment circuit U_S). To do this, the voltage is tapped off from the potential jumper U_M.

This principle is shown schematically in Figure 5-2 for a section of a field multiplexer station.

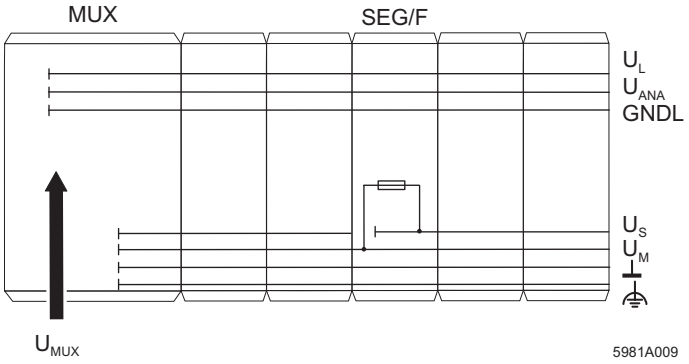

Figure 5-2 Example: Interruption/recreation of the potential jumpers U_S through the segment terminal

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5.2.2 Electrical isolation

Electrical isolation: Remote bus

In order to improve noise immunity, the remote bus interface voltage is isolated from the station's electronics. The incoming remote bus interface shield is AC-coupled to earth ground using a resistor and a capacitor.

Electrical isolation: Functional earth ground/shield

FE and FE capacitive (shield) represent two separate isolated groups.

The field multiplexer does not have electrical isolation for the I/O terminal communications power. U_{MUX} (24 V), U_L (7.5 V) and U_{ANA} (24 V) are not electrically isolated.

The separate supplies for the logic ($U_{MUX,}$ U_L and U_{ANA}) and for the I/O (U_S and U_M) make it easy to set up electrically isolated areas (logic and I/O). Figure 5-3 through Figure 5-5 illustrate various possible implementations of electrical isolation.

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Option 1

The field multiplexer supply U_{MUX} and the I/O supply U_M/U_S are provided from separate power supplies.

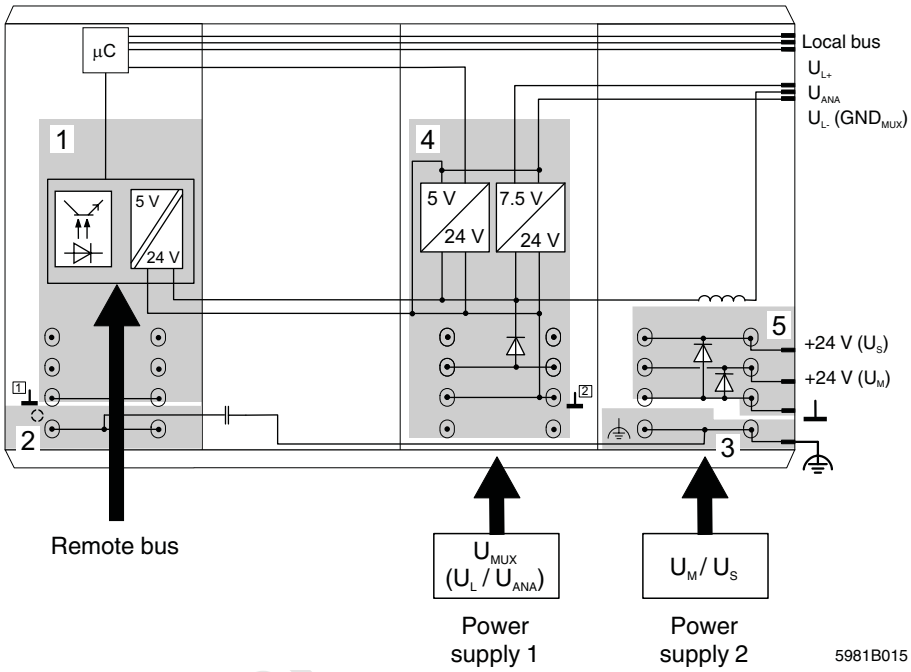

Figure 5-3 Electrical isolation in the field multiplexer (separate power supplies)

Potential areas:

1 Area of remote bus cable

2 Area of functional earth ground (FE) capacitive for shield

3 Area of functional earth ground (FE)

4 Area of the field multiplexer supply U_{MUX} from which the communications power U_L and supply for the analog terminals U_{ANA} are generated.

5 Area of the I/O voltages U_M and U_S

Symbols used:

µC	Microcontroller		Converter
	Optocoupler	1	Reference potential GND_{DATA} (remote bus cable)
	Electrically isolated area	2	Reference potential GND_{MUX} (field multiplexer supply)
	Supply unit with electrical isolation		Shield potential; connected with a capacitor to FE of the potential jumper

This isolation can also be achieved if the power supply U_M/U_S is provided through a separate power terminal with its own power supply (see page 5-8) instead of through the power terminal integrated into the field multiplexer.

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Option 2

The field multiplexer supply U_{MUX} and the I/O supply U_M/U_S are provided from a power supply unit:

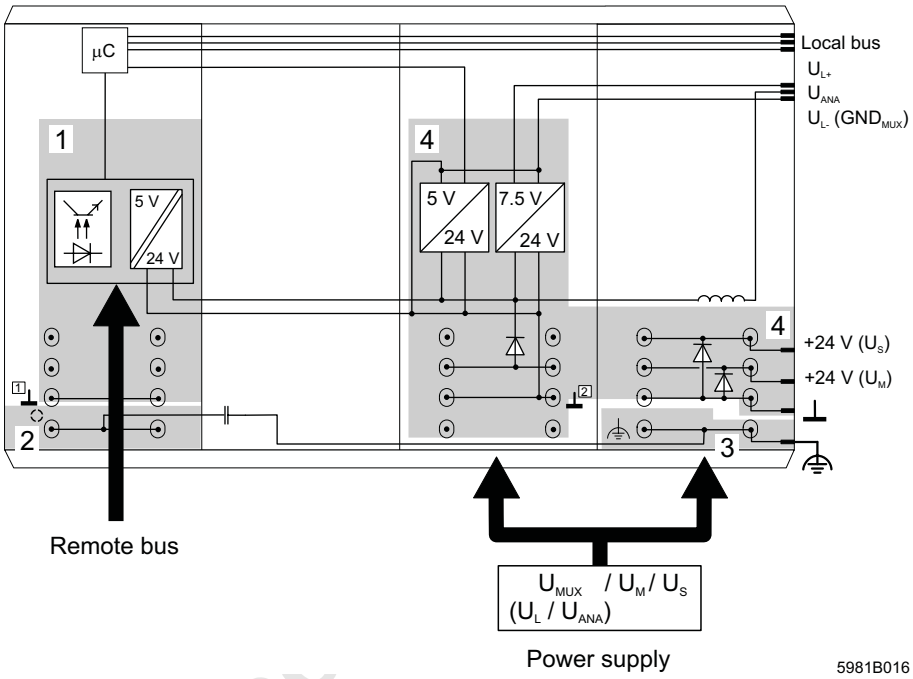

Figure 5-4 Electrical isolation in the field multiplexer (one voltage supply)

Potential areas:

1 Area of remote bus cable

2 Area of functional earth ground (FE) capacitive for shield

3 Area of functional earth ground (FE)

4 Area of the field multiplexer supply U_{MUX} from which the communications power U_L and analog terminal supply U_{ANA} are generated **not isolated** from the I/O voltages U_M and U_S

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Electrical isolation: Digital terminal

Isolation of the I/O circuit of a digital terminal from the communications power is only ensured if U_{MUX} and U_M/U_S are provided from separate power supplies.

Electrical isolation: Analog terminals

The I/O circuit (measuring amplifier) of an analog module receives floating power from the 24 V supply voltage U_{ANA}. The power supply unit with electrical isolation is part of an analog terminal. The voltage U_{ANA} is looped through each terminal and is therefore available to the next terminal.

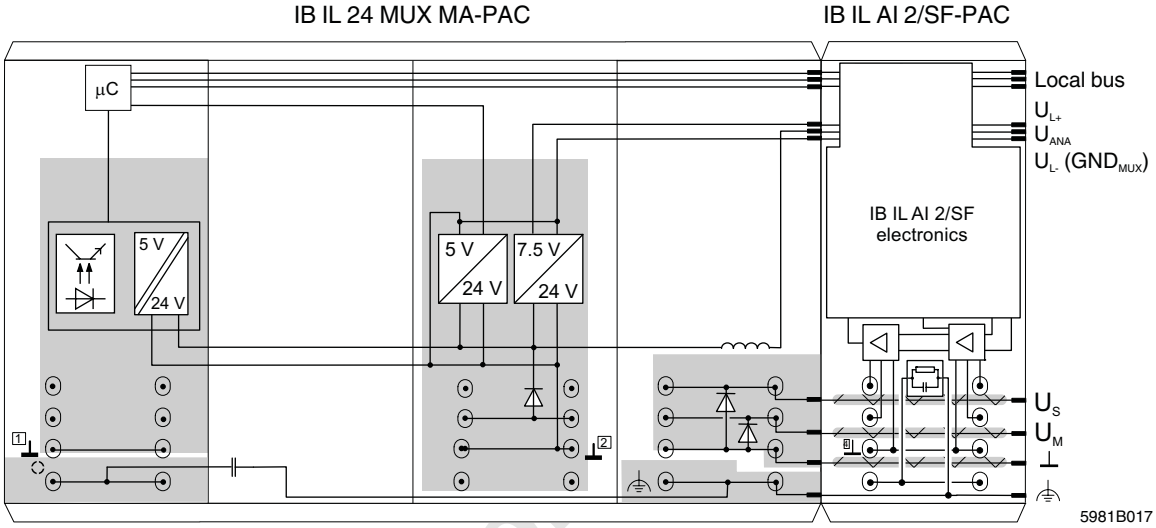

Figure 5-5 Electrical isolation between field multiplexer and analog module

The potential jumpers hatched in the figure are not used in the analog terminal. This means that the 24 V supply of the field multiplexer (U_{MUX}) and the power terminal are electrically isolated from the I/O circuit (measuring amplifier) of the analog terminal. The I/O circuit of the analog module is supplied from the analog circuit U_{ANA}.

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Electrical isolation: Other

Other electrical isolation depends on how the supply voltages are provided. For instance, electrical isolation can be provided by inserting a new 24 V supply using a power terminal. During this process the 24 V power supply units on the low voltage side must not be connected to one another.

One method of electrical isolation using a power terminal is illustrated in Figure 5-6. Connection between the ground of a supply voltage (U_{MUX}, U_S or U_M) and functional earth ground must only be made at one point within the station (point A). Electrical isolation is lost if several grounds are connected to functional earth ground.

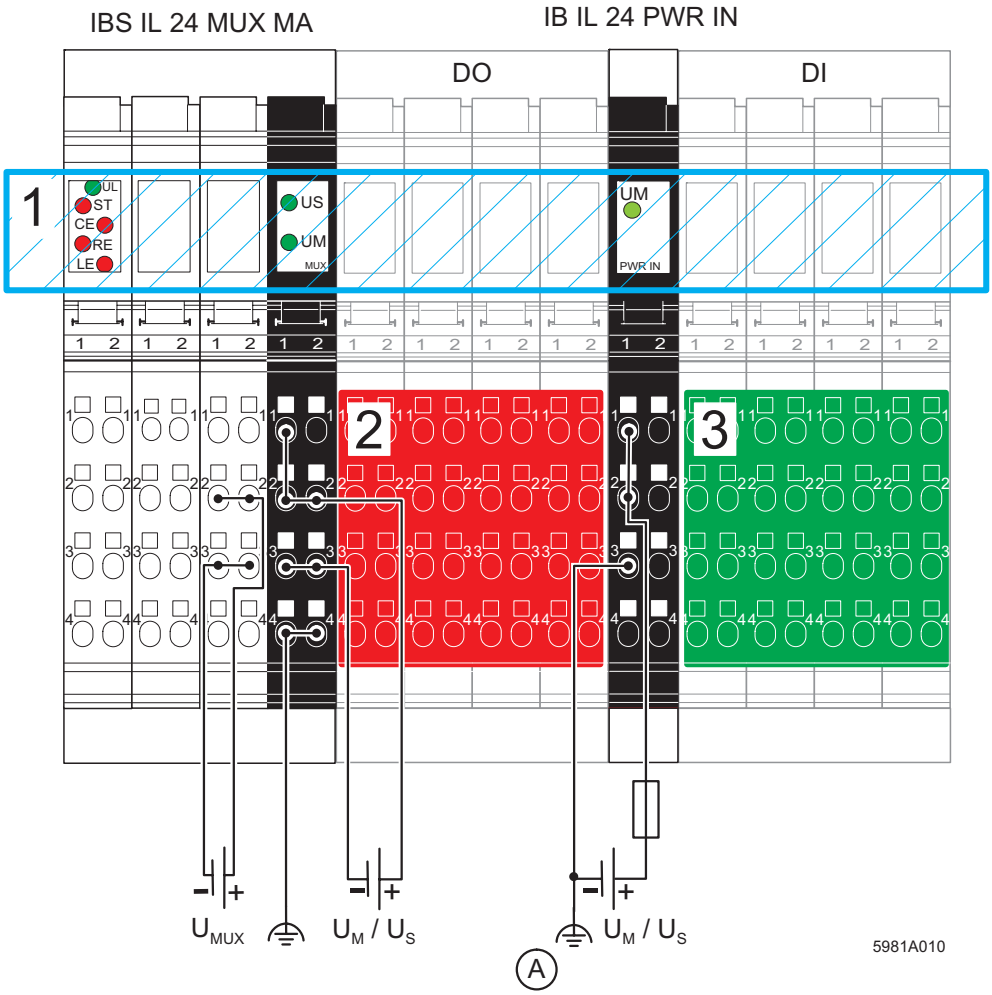

Figure 5-6 Creating electrical isolation

Electrically isolated areas within the station:

1 Bus logic of the complete field multiplexer station

2 I/O (outputs)

3 I/O (inputs)

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6 Surge protection

The following section should be considered as a general guide. If you require information about comprehensive surge protection design, please contact Phoenix Contact.

Overvoltage can occur as a result of circuit events or lightning strikes. Safety equipment against overvoltage should always be installed when installing the field multiplexer, as this is required by the usual fields of application of the field multiplexer.

Field multiplexer systems used outdoors (e.g., for monitoring and control of a sewage treatment plant) are exposed to increased risk of indirect effects of lightning. field multiplexer systems used within industrial plants must also ensure the function and the security of data transmission even in electromagnetically unfavorable circumstances. Safety measures are therefore strongly recommended.

Correct installation and assembly can minimize electromagnetic interference. Particular attention should be paid to the cable layout, described in Section "Transmission over copper cable" on page A-1. Rules for laying the remote bus cable are also given there. Attention must also be paid to appropriate grounding and shielding measures (see Section "Grounding" on page 4-2 and Section "Shielding" on page 4-10).

Before assembling a field multiplexer system, check the surroundings for interference, and select a suitable location.

Install additional modules (e.g., interface converters, surge arresters) as close as possible to the field multiplexer head station.

Overvoltage protection measures include the following points:

– Protecting the remote bus cable
– Protecting the power supply and the entire control cabinet

Surge protection for the remote bus cable does not apply when fiber optics operation is used. No other surge arresters are affected by the choice of the transmission medium. The interface converter must also be included in the overvoltage protection measures.

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6.1 Surge protection for the remote bus cable

Electromagnetic fields affecting the remote bus can disturb data transmission, and in extreme cases can damage the electronics of the field multiplexer. Phoenix Contact offers two surge arresters from the TRABTECH range particularly designed for the field multiplexer to protect the remote bus interface: DATA-PLUGTRAB.

The appropriate ordering data can be found in Section 10.2, "Ordering data" or in the TRABTECH catalog from Phoenix Contact.

Connection methods

The surge arrester for the field multiplexer is connected in a different way, according to the cable type. The following circuit diagrams (Figure 6-2 through Figure 6-5) illustrate various methods of connection.

NOTE:
To operate the field multiplexer under unfavorable electromagnetic interference conditions, Phoenix Contact recommends version 1a and 1b which use a 3-wire, shielded cable. Versions 2 through 4 are not recommended from the point of view of surge protection.

The use of versions 2 through 4 may nevertheless be necessary for the following reasons:

– A cable type other than the recommended type has already been laid
– The distance between the field multiplexer stations is too great for the shielding to be connected (because of increased capacitive load)
– Cost savings are required

Ground both field multiplexer stations (see also "Grounding" and "Additional grounding" on page 4-2).

Version 1a (recommended)

In this version the DATA and $\overline{DATA}$ signals, the reference potential GND_{DATA} and the shield are connected. The surge arrester should be installed as directly as possible next to the field multiplexer head station. The wiring between the field multiplexer and the surge arrester can then be carried out using simple stranded wires. The shield is to be grounded at both ends (Figure 6-1). Connect it using shield clamps of type UFBK-SAS shield clamps at both surge arresters.

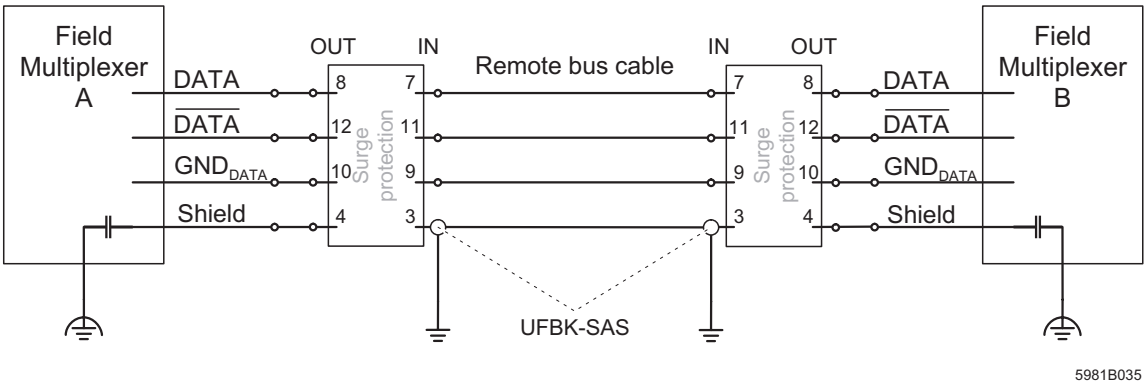

Figure 6-1 Basic circuit diagram: Remote bus protection, version 1a

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Version 1b (recommended)

If it is not possible to implement grounding at both ends because of equalization currents arising as a result of different grounding systems, then

- a double shielded cable is to be used in which the outer shielding is grounded at both ends, or
- a supplementary wire is to be laid for the remote bus cable, or
- ground the shield indirectly using a type TERMITRAB-SLKK5-F/110AC surge arrester (see Phoenix Contact TRABTECH catalog) (Figure 6-2).

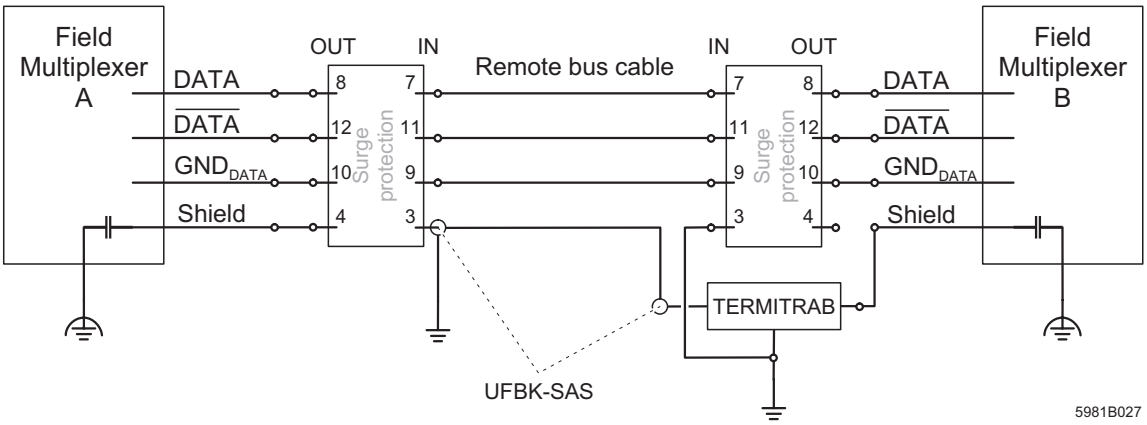

Figure 6-2 Basic circuit diagram: Remote bus protection, version 1b

The remote bus cable is wired between the two surge arresters and the TERMITRAB modular terminal block as illustrated in Figure 6-2. The remote bus cable shield must be connected at both ends using a shield clamp of type UFBK-SAS (see Section 10.2, "Ordering data") to the surge arrester of field multiplexer A and to the TERMITRAB terminal.

Version 2 (not recommended)

This version is suitable if only a 3-wire cable with no shield is available. In this case, only the DATA and $\overline{DATA}$ signals and the reference potential GND_{DATA} are connected. The shield connection of both field multiplexers is left open.

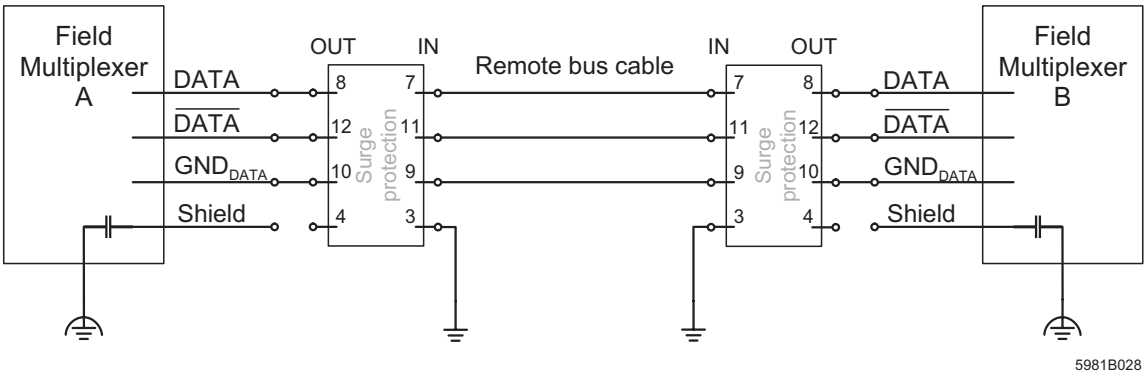

Figure 6-3 Basic circuit diagram: Remote bus protection, version 2

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Version 3 (not recommended)

If all that is available is an unshielded 2-wire remote bus cable, the surge arrester can only be connected to the DATA and $\overline{\text{DATA}}$ signals.

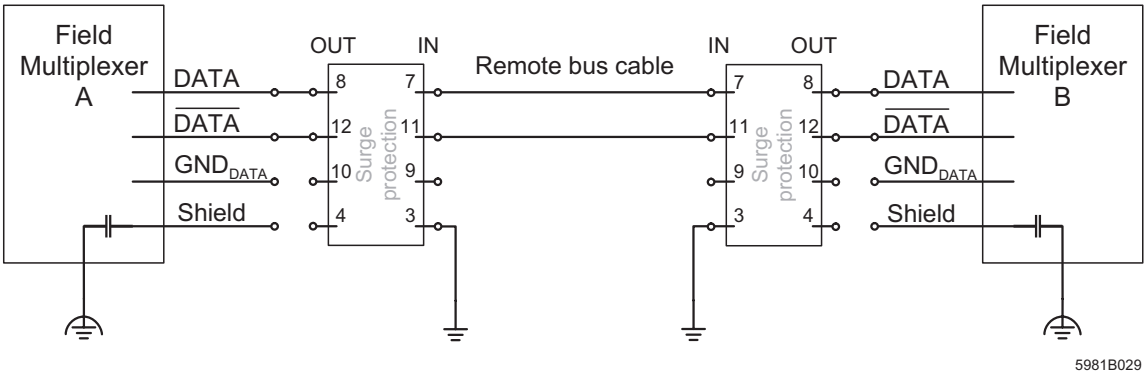

Figure 6-4 Basic circuit diagram: Remote bus protection, version 3

Version 4 (not recommended)

If protection of the remote bus cable is omitted to reduce costs, the field multiplexers must be connected, as shown in Figure 6-5. Surge protection is not provided in this version. Phoenix Contact can therefore not recommend it. The user bears the risk for any consequential damage.

NOTE:
This connection version is not to be used if the DATA and $\overline{\text{DATA}}$ wires are not a twisted pair. The shield must be grounded at both ends of the remote bus cable. To avoid any occurrence of voltage equalization currents, the shield of the remote bus cable of a field multiplexer station should be grounded with a TERMITRAB-SLKK5-F/110AC modular terminal block (see TRABTECH catalog from Phoenix Contact).

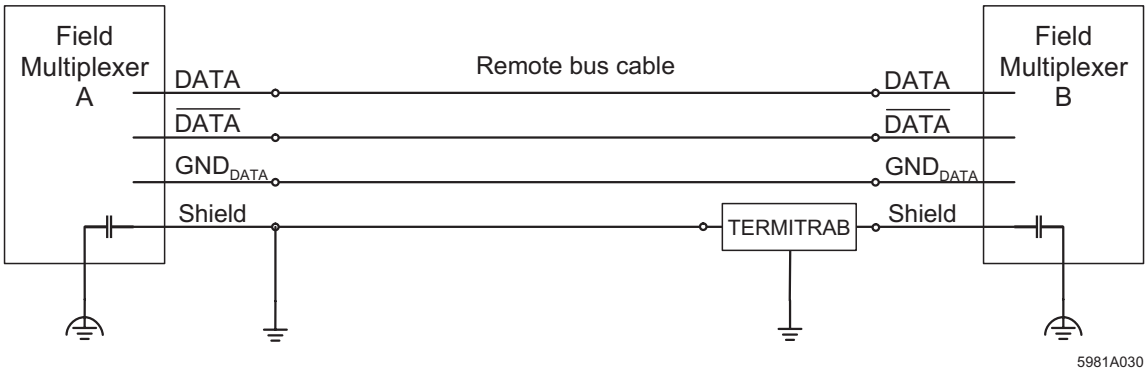

Figure 6-5 Circuit diagram: No remote bus protection

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6.2 Surge protection for the power supply and the entire control cabinet

To protect the control cabinet power supply, Phoenix Contact offers the VALVETRAB surge arrester (see TRABTECH catalog from Phoenix Contact.

Effective overvoltage protection can only be achieved with full equipotential bonding. Inclusion of the module DIN rail in the equipotential bonding can be implemented, for example, with the universal USLKG 5 ground terminal block, Order No. 0441504 (see Section 10.2, "Ordering data" or the CLIPLINE catalog from Phoenix Contact).

Figure 6-6 illustrates an example of the surge protection circuitry for a field multiplexer station. The most important components are shown there, and have the following meanings:

1 Grounding terminals for DIN rail (e.g., UT 10)
2 Surge protection for the control cabinet power supply (e.g., VAL-CP-1S-350)
3 Surge protection for the input/output channels (e.g., PT 4X1-24AC-ST, PT 4X1+F-BE)
4 Surge protection for the remote bus cable (e.g., PT 3-PB-ST, PT 1X2+F-BE)
5 Remote bus cable
6 Field multiplexer supplies
7 Grounding of the metal switch cabinet
8 Other loads with separate power supplies

The variety of possible input and output signals calls for various overvoltage protection measures. The surge arresters from the TERMITRAB, COMTRAB and PLUGTRAB series offer the right protection for every application. Comprehensive advice can be found in the TRABTECH catalog from Phoenix Contact.
Please contact Phoenix Contact if you have more specific questions.

The terminals are to be arranged in such a way that the connecting cables are as short as possible, and that they do not lie in parallel to unshielded cables.

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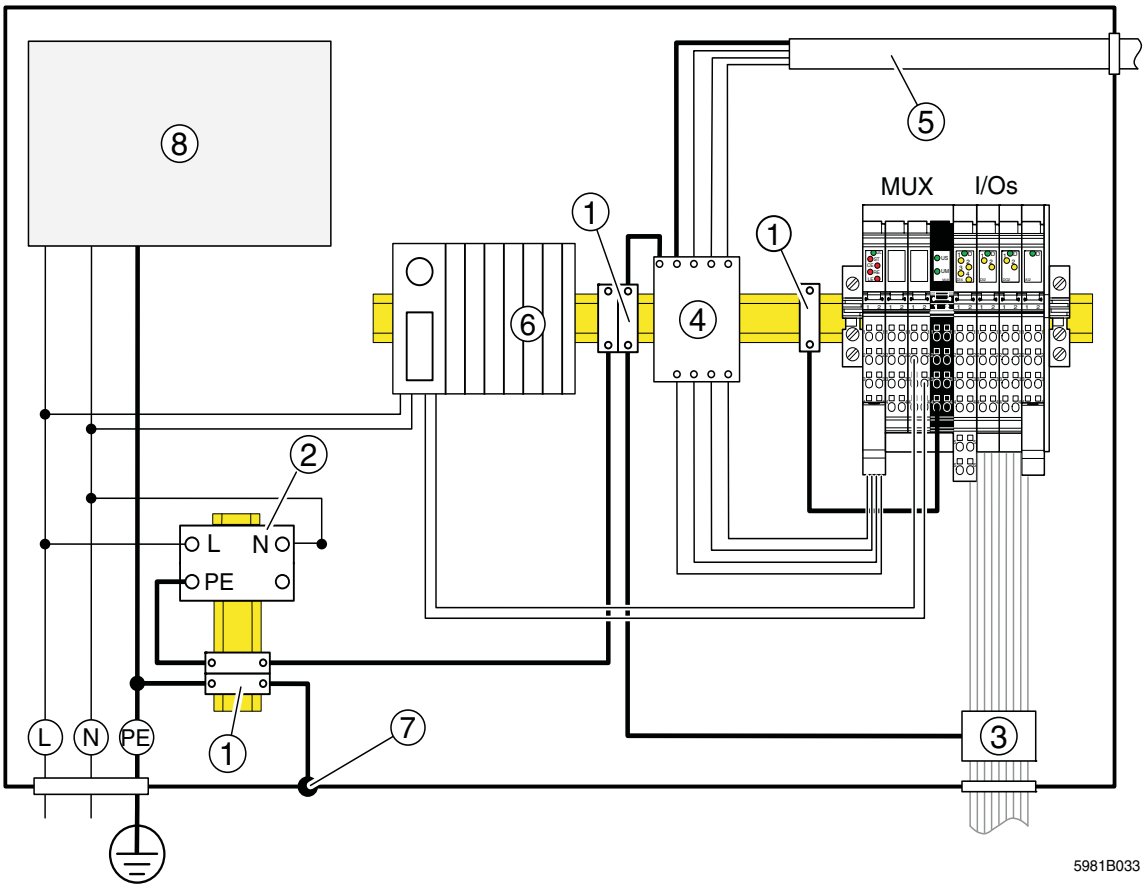

Figure 6-6 Protecting the power supplies

6.3 Surge protection measures in fiber optic mode

Since optical fibers are not sensitive to electromagnetic fields, field multiplexers that transmit data over fiber optics do not need remote bus surge protection. Nonetheless, the power supply unit for the interface converter should be included in the surge protection scheme. Because of the mechanical sensitivity of fiber optics, only fiber types with a strong cladding around the transmission medium should be used.

Applicable fiber optic types can be found in the INTERFACE catalog from Phoenix Contact.

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7 Transmission media

Different media can be used for the signal transmission between field multiplexers depending, for example, on the distance to be covered, the environmental conditions or the existing infrastructure. For data transmission it is often possible to employ cables that have already been laid but are not in use.Table 7-1 provides an overview of possible transmission media and lists advantages that might be decisive for the selection.

Table 7-1 Possible transmission media

Medium	Transmission distance	Advantages	Converter (C)/ Modem (M) required
Copper cable	Up to 12 km	Use of existing data cables	No
Fiber optic cable	From 100 m up to 45 km	Not sensitive to surge voltages (e.g., outdoor lightning strikes) For use in environments subject to high levels of electromagnetic interference Electrical isolation of system parts/buildings	Yes (C)
Telephone line	Almost unlimited, depending on the type of telephone line (private permanent line up to 20 km)	Use of public telephone lines possible	Yes (C/M)
Bluetooth (Wireless)	Up to 150 m	Wireless transmission	Yes (C)
Ethernet	Almost unlimited, depending on the signal delay in the network	Use of existing Ethernet networks	Yes (C)

When selecting the transmission medium, please note that the number of signals to be transmitted is limited for Bluetooth or Ethernet transmission:

Table 7-2 Restrictions for signal transmission

Medium	Maximum number of signals to be transmitted
Bluetooth (Wireless)	50 digital and 2 analog signals
Ethernet	4 analog signals, no restrictions for digital signals

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Table 7-3 Typical copper cables

Cable type	Theoretical range* [km]	Cable parameters			
		Cable resistance [Ω/km]	Cross resistance [GΩ * cm]	Inductance [mH/km]	Operating capacitance [nF/km]
J-Y(ST)Y ... 0,6 Lg (Telephone line, 0.6 mm)	3.4	65	10	–	120
J-Y(ST)Y ... 0,8 Lg (Telephone line, 0.8 mm)	4.9	36.6	10	–	100
LiYCY(TP) 2x2x1 (Data cable, shielded, 1 mm^2)	5.3	20	20	0.65	160

* The value specified is to be considered as a guide value only. Shorter and longer distances are possible depending on the surrounding conditions.

Please refer to the Appendix A „Technical appendix: The field multiplexer with different transmission media“ for information on component wiring and configuration of the converters (and modems when using a telephone line).

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8 Configuring and installing the field multiplexer systems with the help of an example project

This section will use an example project to illustrate the configuration and installation of a field multiplexer station. It is designed to help you to carry out the following steps on your own project.

The following sequence should be observed during configuration and installation:

- Describe and define the task
  (number of signals, transmission medium, distance etc.)
- Select the required I/O terminals
- Consider the system restrictions
- Select suitable power supply units
- Provide surge protection
- Select the transmission medium
- Determine the transmission time
- Install the system and configure the field multiplexer

8.1 Describing and defining the task

Example project

Signals are to be transmitted from a control room to a pumping station over a distance of 3.2 km. An existing copper cable can be used as the transmission medium. 4 digital input signals, 2 digital output signals and 2 analog input signals are to be transmitted.

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8.2 Selecting the required I/O terminals

For operation, the field multiplexer station I/O terminals must be set up in a complementary arrangement (see also Figure 3-1 on page 3-1). The field multiplexer does not process the transmitted data, but merely transmits it to the opposite station.

Select the appropriate Inline terminals for the I/O signals in your project.

8.2.1 Devices permitted in a field multiplexer station

You will find a list of I/O terminals that can be operated on the field multiplexer including the corresponding order numbers in the AH IL BK IO LIST application note.

Table 8-1 shows possible terminal combinations in a complementary station arrangement.

NOTE: Configuration error

Terminal combinations other than the ones listed in Table 8-1 are not permitted. They will be detected as configuration errors and indicates with the CE LED (see Section "Diagnostic indicators" on page 4-3).

The IB IL AI 2/SF-PAC analog terminal can also be combined with two IB IL AO 1... terminals, see also Table 8-2.

Further information on the current and voltage ranges of the permissible analog terminals can be found in the terminal-specific data sheets.

Key for the table below:

1, 2, 4, 8, 16, 32	Number of available channels
–	Combination not possible
+	If possible, use the IB IL 24 DO 2-PAC terminal as a complementary terminal for a power or segment terminal, as only the fuse and not the main voltage is monitored.

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Table 8-1 Complementary terminal arrangement

Outputs / Inputs	IB IL 24 PWR IN/F-D-PAC	IB IL 24 PWR IN/2-F-D-PAC	IB IL 24 PWR IN/2-F-DF-PAC	IB IL 24 SEG/F-D-PAC	IB IL 120 PWR IN/F-D-PAC	IB IL 120 DI 1-PAC	IB IL 230 DI 1-PAC	IB IL 24 DI 2...	IB IL 24 DI 4...	IB IL 24 DI 8...	IB IL 24 DI 16...	IB IL 24 DI 32/HD...	IB IL AI 2/SF...	IB IL 24 SAFE 1-PAC
IB IL DO 1 AC-PAC	1^+	1^+	1^+	1^+	1^+	1	1	1	–	–	–	–	–	–
IB IL 24 DO 2...	2	2	2	2	2	1	1	2	–	–	–	–	–	2
IB IL 24 DO 4...	–	–	–	–	–	–	–	–	4	–	–	–	–	–
IB IL 24 DO 8...	–	–	–	–	–	–	–	–	–	8	–	–	–	–
IB IL 24 DO 16...	–	–	–	–	–	–	–	–	–	–	16	–	–	–
IB IL 24 DO 32/HD...	–	–	–	–	–	–	–	–	–	–	–	32	–	–
IB IL 24/230 DOR 1/W(-PC)-PAC	1^+	1^+	1^+	1^+	1^+	1	1	1	–	–	–	–	–	–
IB IL 24/230 DOR 4/W(-PC)-PAC	–	–	–	–	–	–	–	–	4	–	–	–	–	–
2 x IB IL AO 1/SF-PAC	–	–	–	–	–	–	–	–	–	–	–	–	2	–
2 x IB IL AO 1/U/SF-PAC	–	–	–	–	–	–	–	–	–	–	–	–	2	–
1 x IB IL AO 1/SF -PAC **1 x IB IL AO 1/U/SF-PAC**	–	–	–	–	–	–	–	–	–	–	–	–	2	–
1 x IB IL AO 2/U/BP...	–	–	–	–	–	–	–	–	–	–	–	–	2	–

Key:

IB IL 24 DI 2...	IB IL 24 DI 2-PAC	IB IL 24 DO 2...	IB IL 24 DO 2-PAC
	IB IL 24 DI 2-NPN-PAC		IB IL 24 DO 2-NPN-PAC
IB IL 24 DI 4...	IB IL 24 DI 4-PAC		IB IL 24 DO 2-2A-PAC
	IB IL 24 DI 4-ME	IB IL 24 DO 4...	IB IL 24 DO 4-PAC
IB IL 24 DI 8...	IB IL 24 DI 8-PAC		IB IL 24 DO 4-ME
	IB IL 24 DI 8-PAC/SN	IB IL 24 DO 8...	IB IL 24 DO 8-PAC
	IB IL 24 DI 8/T2-PAC		IB IL 24 DO 8-PAC/SN
IB IL 24 DI 16...	IB IL 24 DI 16-PAC		IB IL 24 DO 8-NPN-PAC
	IB IL 24 DI 16-ME		IB IL 24 DO 8-2A-PAC
	IB IL 24 DI 16-NPN-PAC	IB IL 24 DO 16...	IB IL 24 DO 16-PAC
	IB IL 24 DI 16-PAC/SN		IB IL 24 DO 16-ME
IB IL 24 DI 32/HD...	IB IL 24 DI 32/HD-PAC		IB IL 24 DO 16-PAC/SN
	IB IL 24 DI 32/HD-NPNPAC	IB IL 24 DO 32/HD...	IB IL 24 DO 32/HD-PAC
			IB IL 24 DO 32/HD-NPNPAC

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IB IL AI 2/SF...	IB IL AI 2/SF-PAC IB IL AI 2/SF-230-PAC IB IL AI 2/SF-ME	IB IL AO 2/U/BP...	IB IL AO 2/U/BP-PAC IB IL AO 2/U/BP-ME

Table 8-2 Possible combinations of analog I/O terminals

Terminal	Signal	IB IL AO 1/SF-PAC 0 V ... 10 V	IB ILAO 1/SF-PAC 0 mA ... 20 mA	IB IL AO 1/U/SF-PAC 0 V ... 10 V	IB ILAO 2/UBP-PAC 0 V ... 10 V	IB IL AO 2/UBP-PAC ±10 V
IB IL AI 2/SF-PAC	±10 V					x
IB IL AI 2/SF-PAC	0 V ... 10 V	x		x	x	
IB IL AI 2/SF-PAC	4 mA ... 20 mA		x			
IB IL AI 2/SF-PAC	0 mA ... 20 mA		x			

NOTE: Malfunction

Typically, digital terminals with the same number of channels are always combined (e.g., DI **4** with DO **4**). For instance, DI **16** with 2 * DO **8** is **not** permitted.

There is one exception:

1-channel DO output terminals can be combined with the IB IL 24 DI 2-PAC input terminal. The second channel, however, cannot be used in this case.

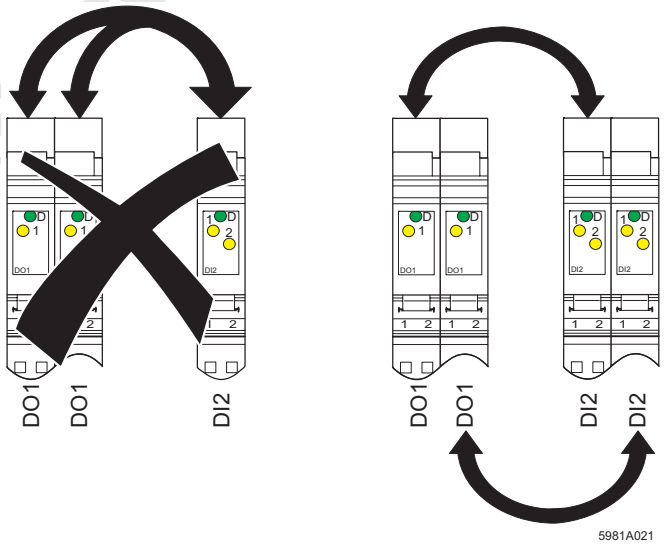

Figure 8-1 Combining DO 1 and DI 2 terminals

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Example project

The following components are needed in the **master station** for the example project on page 8-1:

Table 8-3 Components of the master station

Position	Order Designation	Number	Function
1	**IB IL MUX MA-PAC**	1	Field multiplexer as the head of the master station
2	**IB IL 24 DI 4-PAC**	1	Connection of 4 digital input signals using 2 or 3-wire technology
Or	IB IL 24 DI 2-PAC	2	Connection of 4 digital input signals using 4-wire technology
3	**IB IL 24 DO 2-2A-PAC**	1	Connection of 2 digital output signals
4	**IB IL AI 2/SF-PAC**	1	Connection of 2 analog input signals

The following complementary terminals are used on the **slave station**:

Table 8-4 Components of the slave station

Position	Order Designation	Number	Function
1	**IB IL MUX MA-PAC**	1	Field multiplexer as the head of the slave station
2	**IB IL 24 DO 4-PAC**	1	Connection of 4 digital output signals using 2 or 3-wire technology
Or	IB IL 24 DO 2-2A-PAC	2	Connection of 4 digital output signals using 4-wire technology
3	**IB IL 24 DI 2-PAC**	1	Connection of 2 digital input signals
4	**IB IL AO 1/SF-PAC**	2	Connection of 2 analog output signals (voltage or current signals)
Or	IB IL AO 1/U/SF-PAC	2	Connection of 2 analog output signals (voltage signals)
Or	IB IL AO 2/U/BP-PAC	1	Connection of 2 analog output signals (voltage signals)

The 4-channel terminals are selected at position 2.

In the slave station the terminal for current and voltage signals is selected at position 4.

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8.2.2 Checking the system limits

During field multiplexer station configuration, observe the system specifications. They are specified in Section "Number of devices in a field multiplexer station" on page 3-4.

Checking system limits:

Table 8-5 Checking system limits

	System limit	Master station	Slave station
Devices in the station	63, maximum	4, maximum	4, maximum
Number of signals	512, maximum	4 DI + 2 DO + 2 AI => 4 + 2 + 2*16 = 38	4 DO + 2 DI + 2 AO => 4 + 2 + 2*16 = 38
Current at U_L	2 A, maximum	0.165 A (see Table 8-6)	0.159 A (see Table 8-7)
Current at U_{ANA}	0.5 A, maximum	0.018 A (see Table 8-6)	0.130 A (see Table 8-7)
Current at $U_S + U_M$	8 A, maximum	5 A (see Table 8-6)	2.5 A (see Table 8-7)

Please refer to the terminal-specific data sheets or the DB GB IB IL DEVICE LIST data sheet for the current consumption of the terminals.

Table 8-6 Maximum current consumption of the master station devices

Position	Order Designation	Number	U_L [mA]	U_{ANA} [mA]	U_M [A]	U_S [A]
2	IB IL 24 DI 4-PAC	1	40			1
3	IB IL 24 DO 2-2A-PAC	1	35			4
4	IB IL AI 2/SF-PAC	1	60	18		
	Sum (maximum)		**135**	**18**		**5**

Table 8-7 Current consumption of the slave station

Position	Order Designation	Number	U_L [mA]	U_{ANA} [mA]	U_M [A]	U_S [A]
2	IB IL 24 DO 4-PAC	1	44			2
3	IB IL 24 DI 2-PAC	1	35			0.5
4	IB IL AO 1/SF-PAC	2	2*40 = 80	2*65 = 130		
	Sum (maximum)		**159**	**130**		2.5

The system limits are observed with the selected terminals. Additional power terminals are not necessary.

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8.3 Selecting suitable power supply units

See also Section "Power supplies and voltage concept" on page 5-1.

The selection of suitable power supplies always depends on the individual system. 24 V DC power supplies should always meet the following criteria:

Nominal value:	24 V DC
Ripple:	5%
Permissible range:	19.2 V to 30 V (ripple included)

Electrical isolation

If electrical isolation is required between logic and I/O you must provide the field multiplexer supply U_{MUX} and the I/O supply U_M/U_S from separate power supplies.

If you want to set up various electrically isolated areas within a field multiplexer station, use additional power terminals that draw their current from separate power supplies.

Notes on setting up electrically isolated areas can be found in Section "Voltage concept within an field multiplexer station" on page 5-3.

Example project

There is no electrical isolation required between logic and I/O in the example project.

The master and the slave stations are be supplied from separate voltage sources.

One voltage source provides both the field multiplexer supply (U_{MUX} to generate U_L and U_{ANA}) as well as the I/O supply (U_S and U_M) for a station.

A selection of suitable power supply units can be found in Section "Ordering data" on page 10-6 or in the INTERFACE catalog from Phoenix Contact.

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8.4 Providing surge protection

Surge protection measures are described in Section "Surge protection" on page 6-1.

- Select a protection of the remote bus.
  Version 1a is selected for the example.
- Also provide protection for the power supply and the entire control cabinet.

8.5 Selecting the transmission medium

Possible transmission media are described in Section "Transmission media" on page 7-1.

- Select a transmission medium that meets your demands.
  Transmission over a copper remote bus cable is selected for the example.

8.6 Determining the transmission time

The formulas to calculate the transmission time are given in Section "ransmission time" on page 3-3.

The example station (see Figure 8-2) is equipped with a copper cable. Therefore, the formula for copper cables is used for the calculation.

$$t_{up} = n * 6.8 \text{ ms/byte} + 78 \text{ ms}$$

t_{up} = Update time for field multiplexer I/O data

n = Number of bytes to be transmitted (n = 1 ... 64 bytes)

Calculation of n:

Terminals used:	DI 4	DI 2	DO 2	AI 2
Number of bytes to be transmitted per terminal:	1	1	1	4
Total number of bytes to be transmitted:	**n = 1 + 1 + 1 + 1 + 4 = 7**			

This results in the following transmission time:

$$t_{up} = \mathbf{n} * 6.8 \text{ ms/byte} + 78 \text{ ms} = \mathbf{7} \text{ bytes} * 6/8 \text{ ms/byte} + 78 \text{ ms}$$

$$t_{up} = 125.6 \text{ ms}$$

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8.7 Installing and configuring the field multiplexer system

8.7.1 Basic information for installation

As a rule, follow the instructions of the IL SYS INST UM E when installing the field multiplexer and the connected Inline terminals.

Observe in particular the following points during installation:

Disconnect the power!

Before setting up a field multiplexer station or inserting a terminal into a station, ensure that the entire station is disconnected from the power. Make sure the entire station is reassembled before switching the power back on.

Order of the Inline terminals

Install analog terminals in a field multiplexer station to the right of digital terminals, as otherwise the field multiplexer station reports a configuration error and the field multiplexer system is not ready for operation. For later extensions, insert digital terminals before analog terminals.

FE connection

To ensure reliable grounding of the field multiplexer station, ground the field multiplexer through the FE connection. Connect the terminal points for the FE connection to a grounded PE terminal (e.g., USLKG 5 universal ground terminal block, Order No. 0441504, see also Figure 4-1 "Additional grounding of the field multiplexer").

End plate

Terminate each field multiplexer station with an end plate. It is supplied as standard with the field multiplexer.

End clamp

Lock every field multiplexer station with end clamps at the beginning and the end of the station (see Section "Ordering data" on page 10-6).

Electrical isolation

If you want to set up various electrically isolated areas within a field multiplexer station, use additional power terminals that draw their current from separate power supplies.

I/O terminals

For information about the connection of I/O terminals and of sensors and actuators, please refer to IL SYS INST UM E user manual and the terminal-specific data sheets.

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8.7.2 Arrangement of the field multiplexer system

Figure 8-2 illustrates the arrangement of the station and the opposite station in the example project.

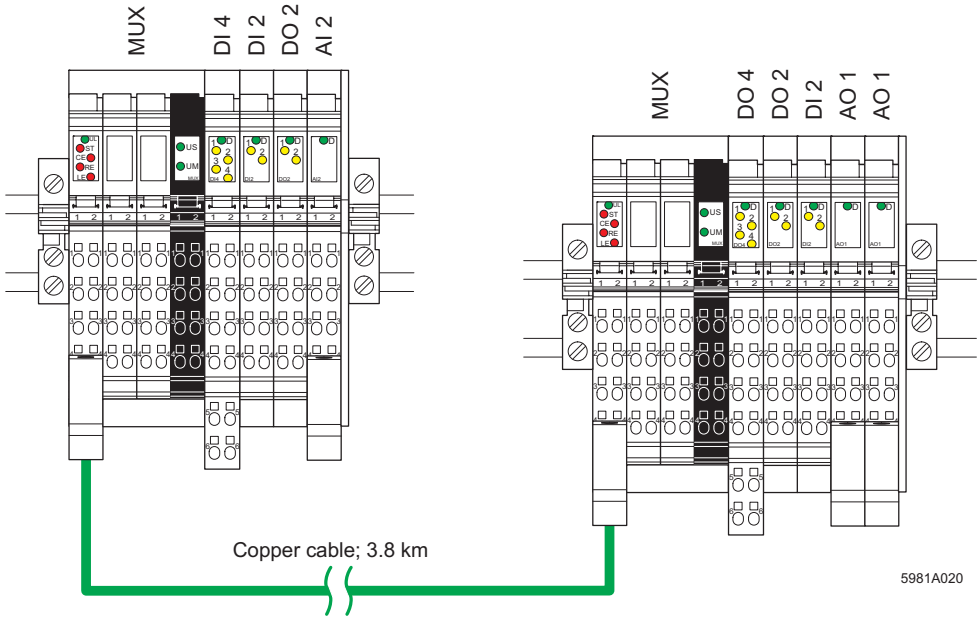

Figure 8-2 Typical arrangement of an field multiplexer system

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8.7.3 Connecting and configuring the field multiplexer

Wire the Inline connectors according to Section "Terminal point assignment" on page 4-4.

- Connect the remote bus cable.

For interference-free transmission, Phoenix Contact recommends at least a 3-wire shielded cable. In this case, connector 1 of both stations should be connected to the DATA, $\overline{DATA}$, and GND_{DATA} signals and the shield. In addition, DATA and $\overline{DATA}$ should be a twisted pair.

- If you are using fiber optic conductors configure the FO transmission mode.
  To do so, insert a jumper from 1.1 to 2.1 ($CONF_{FO}$) at connector 1 of the field multiplexer (see also Figure 8-3).

NOTE: Malfunction
Make sure that the same transmission mode is always set for both field multiplexers.

  For fiber optic transmission set the required FO converters to a transmission rate of 75 kbaud (see also Section "Transmission over fiber optics" on page A-3). Field multiplexer and FO converter are linked with the IB IL MUX-CAB PSI adapter cable (see also Section "Ordering data" on page 10-6).
- If you use another transmission medium (telephone line, Bluetooth, Ethernet) the jumper from 1.1 to 2.1 ($CONF_{FO}$) at connector 1 of the field multiplexer must not be inserted. Set additional system components accordingly. See
  Section "Transmission over telephone line (modem)" on page A-7,
  Section "Transmission over Bluetooth (wireless)" on page A-15 or
  Section "Transmission over Ethernet (COM SERVER)" on page A-33.
- Configure master and slave
  One field multiplexer station **must** be configured as the master. To do this, insert a jumper at connector 3 from 1.4 to 2.4 ($CONF_{MA}$) (see Figure 8-3).
  The second station **must** be configured as a slave. It must not have a jumper at connector 3 from 1.4 to 2.4.
- Connect the power supply.
  If a field multiplexer station is to be supplied from a shared 24 V DC supply (U_{MUX}, U_S and U_M), three jumpers must be inserted for this purpose (see Figure 8-3).

In this case there is **no** electrical isolation between U_{MUX} and U_S / U_M.

NOTE: Overload
Use both of the adjacent contacts to supply the main voltage U_M and to supply and/or tap the segment voltage U_S.

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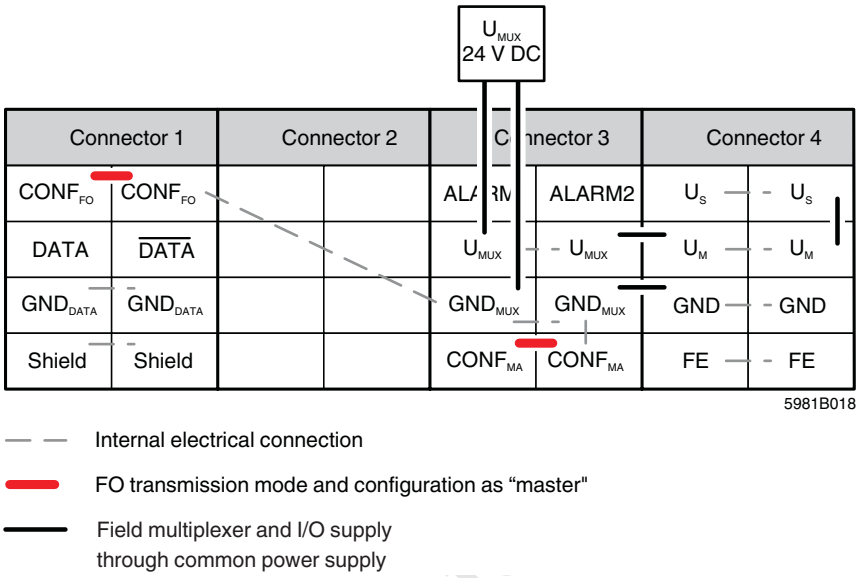

Figure 8-3 Field multiplexer wiring example

Example project

If you want to power the field multiplexer and all I/Os using a single power supply unit, you can connect the power to the field multiplexer as shown in Figure 8-3. The jumper on connector 1 ($CONF_{FO}$) is omitted, as the transmission medium is copper in the example project (see page 8-1). The jumper on connector 3 ($CONF_{MA}$) must only be inserted at the master station.

Alarm contact

The field multiplexer has **a floating** alarm output (Alarm_IN and Alarm_OUT contacts at connector 3) that allows to indicate operating errors remotely. The contact is normally open, but it is closed in the event of an error and when the field multiplexer power supply fails.

Notes on the current carrying capacity of the alarm contacts can be found in the technical data in the Appendix.

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9 Commissioning and functional test

The field multiplexer system functions autonomously. The automatic startup of the system, with its comprehensive selftest routines and automatic data assignment, eliminates the need for time-consuming system configurations and avoids sources of error. Commissioning is therefore very easy.

9.1 Checking the installation

The following points should be checked before the system is switched on, or if an error occurs:

Table 9-1 Checking the installation

Step		Reference to documentation
1	Are all the Inline terminals approved for use in the field multiplexer system?	AH IL BK IO LIST application note
2	Is the assignment of the terminals correct (complementary arrangement)?	Table 8-1 on page 8-3
3	Are all the system limits observed?	Section "Checking the system limits" on page 8-6
4	Are the field multiplexer stations correctly configured (master/slave, copper/fiber optic)?	Section "Connecting and configuring the field multiplexer" on page 8-11
5	If any interface converters are connected, are they ready-to-operate?	
6	Has the wiring of the power supply/supplies for the field multiplexer and all other terminals been installed correctly?	Figure 8-3 on page 8-12
7	Are all the sensors and actuators connected correctly to the I/O terminals?	Terminal-specific data sheets

If all of these points have been checked, the voltage supply of the field multiplexer system can be switched on.

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9.2 Startup behavior and system test

Startup

When the supply voltage U_{MUX} (24 V DC) of the field multiplexer has been switched on, the diagnostic LEDs UL, ST, CE, RE and LE light up for approximately one second (lamp test). Then the ST, CE, RE and LE LEDs go out for one second. In these two seconds, the connected I/O terminals initialize themselves and also receive their logic voltage when U_{MUX} is switched on.

System test

After startup, the field multiplexer changes to the stop state (ST LED on) and carries out a system test. This involves the following activities:

- Reading the "master/slave" and "copper/fiber optic" configuration signals
- Testing of the field multiplexer hardware
- Examination of the local field multiplexer station
- Making contact with the opposite station and exchange of configuration data and status messages
- Comparing of the two configurations
- Opening the alarm relay and switching off the ST LED if there are no errors

The system test activities mentioned above require about 0.5 s if there are no errors.

After the system test, the field multiplexers start normal operation. If an error occurs during one of these activities, the corresponding diagnostic LEDs light up, and the field multiplexer starts again by testing the field multiplexer hardware. If the same error continues to occur upon startup, there will be a permanent error indication that can be evaluated for service purposes. The field multiplexers will nevertheless continue to attempt to start the system.

Please refer to Section "Diagnostic indicators" on page 4-3 for information on the diagnostic indicators of the field multiplexer.

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9.3 Operation

If all the green LEDs on the field multiplexer and the I/O terminals light up, the field multiplexer station is operating, and data transmission is active.

NOTE: Malfunction
Changes to a local bus configuration during operation are not permitted **under any circumstances**. Always **switch off power** first before you make any changes to the field multiplexer system.

The following activities take place during normal operation:

- Exchange process data on the local buses, and between a station and its opposite station over the remote bus
- Display of I/O errors
- Monitoring of the field multiplexer timeout

Controlling the alarm relay

If data transmission is not possible within a predefined period (timeout), the alarm relay is activated (see also "Flowchart" on page 9-8). Both field multiplexer stations enter the stop state, and a reset is generated at both stations.

Only the digital outputs are reset. The analog terminal outputs remain unchanged (maintain their last value), while the stations are stopped.

The field multiplexer system automatically tries to start up again after a timeout or after a reset. If no error is found when restarting (remote bus and local bus operating correctly and correctly configured for each other), data transmission is resumed automatically. If an error is found, the field multiplexers will continue to attempt to restart the system.

The alarm relays at the two field multiplexer stations are not always triggered at the same time, as error detection occurs at each station independently of the remote station. For instance, if the power to one field multiplexer station fails, the alarm relay is triggered at the affected station immediately, but it may take up to 1 s before the opposite station triggers.
If one station stops, the second station will always change to stop state as well.

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9.4 Diagnostic indicators

The five LEDs on the left of the field multiplexer have the following meanings (see also Section "Diagnostic indicators" on page 4-3):

Table 9-2 Diagnostic LEDs on the field multiplexer

LED	Color	Meaning of the LED
UL	Green	**U_{Logic}** (Field multiplexer supply, communications power and interface supply)
ST	Red	**St**op (Field multiplexer is in the stop state)
CE	Red	**C**onfiguration **E**rror
RE	Red	**R**emote Bus **E**rror
LE	Red	**L**ocal Bus **E**rror (Error on the local bus of this field multiplexer station, e.g., a faulty I/O terminal)

9.4.1 Error causes and remedies

The LEDs on the field multiplexer do not light up or flash alone, but always together with others. Each combination indicates a specific malfunction, which can then be localized and rectified.

The various LED combinations are described in Table 9-3. The symbols used have the following meanings:

Symbol	Meaning
○	LED OFF
⊙	LED flashing
●	LED ON

Table 9-3 Possible LED combinations

No.	UL	ST	CE	RE	LE	Error	Remedy
1)	○	○	○	○	○	Logic and interface power not present	Check field multiplexer supply U_{MUX}
2)	⊙	●	○	○	○	Interface supply not present and/or hardware faulty	Send field multiplexer for service
3)	●	●	●	○	○	– Error on remote bus – "Master/slave" or "copper/fiber optic" configuration incorrect – Opposite station not switched on or faulty	– Check remote bus connection – Check field multiplexer configurations ("master/slave" and "copper/fiber optic" jumpers properly inserted?), see page 4-8 – Check interface converter (if present) – Check supply of opposite station

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Table 9-3 Possible LED combinations

No.	UL	ST	CE	RE	LE	Error	Remedy
4)	●	●	●	●	○	(Same as 3) and local bus not operable	– See 3) – Check correct position of the terminals – Check local bus supply
5)	●	●	●	●	●	(Same as 3) and local bus configuration not permitted	– See 3) – Check local bus configuration (are all the terminals permitted, and is the arrangement complementary?), see page 8-2
6)	●	●	⊙	○	○	Different firmware versions on the field multiplexer stations	– Only use field multiplexers with the same firmware in the system – Replace the field multiplexer – Send field multiplexer for service
7)	●	●	○	●	○	Local bus not operable (bus error)	– Check correct position of the terminals – Check local bus supply – Check the LEDs on the devices (D LED flashing?), see terminal-specific data sheets or Section "Localizing errors on a field multiplexer station" on page 9-6
8)	●	●	○	●	●	Local bus configuration not permitted	Check local bus configuration, see page 8-2
9)	●	●	○	⊙	○	Local bus of the opposite station not operable	– Check correct position of the terminals – Check local bus supply of the opposite station – Check the LEDs on the devices (D LED flashing?), see terminal-specific data sheets or Section "Localizing errors on a field multiplexer station" on page 9-6
10)	●	●	○	⊙	⊙	Local bus configuration of the opposite station not permitted	– Check local bus configuration of the opposite station, see page 8-2
11)	●	●	○	○	●	The local bus configurations of the two stations do not correspond	– Check local bus configurations of the both stations, see page 8-2
12)	●	○	○	●	○	I/O error on the local station	– Check I/O supply of the local station
13)	●	○	○	⊙	○	I/O error on the opposite station	– Check I/O supply of the opposite station
14)	●	○	○	○	○	Field multiplexer system operating	–

The errors have the following priority:

– An error on the local station has a higher priority than an error on the opposite station.
– A bus error has a higher priority than a configuration error.

Example: One station is operating correctly, the other station is faulty and has an illegal configuration. The faulty bus must be repaired before the field multiplexer stations can display the configuration error.

NOTE: Malfunction

Changes to a local bus configuration during operation are not permitted **under any circumstances**. Always **switch off power** first before you make any changes to the field multiplexer system.

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9.4.2 Localizing errors on a field multiplexer station

Diagnostic and status indicators on a field multiplexer station show the location of errors clearly. An error is displayed on the station using LEDs.

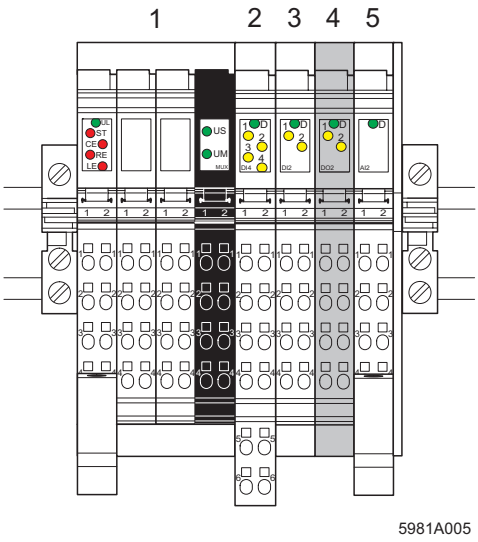

Figure 9-1 Example station for error localization

Terminals used in the example station:

1 IB IL MUX MA-PAC
2 IB IL 24 DI 4-PAC
3 IB IL 24 DI 2-PAC
4 IB IL 24 DO 2-2A-PAC
5 IB IL 24 AI 2-PAC

When the system is operating correctly, the green LEDs on the field multiplexer and the other terminals remain lit (Figure 9-2, A). All the red LEDs are off.

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Example

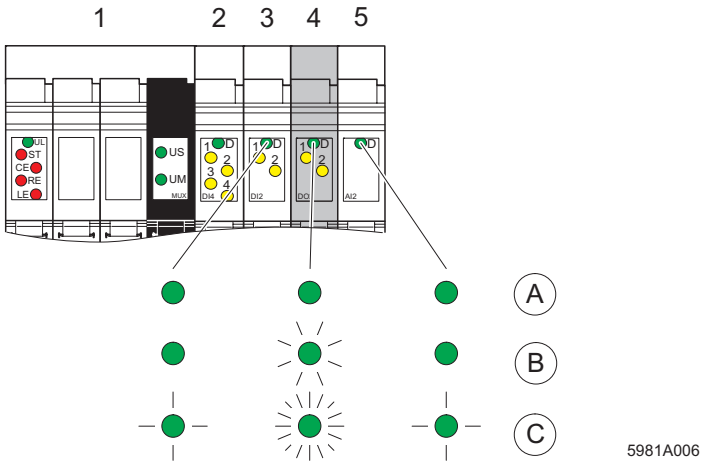
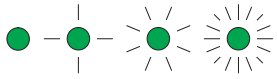


Figure 9-2 Station with example diagnostic indicators (states A to C)

Figure 9-2 shows a station with two example error states. It shows that an I/O error has been detected at terminal 5 or that terminal 4 has failed and shows the behavior of the diagnostic indicators on the adjacent terminals.

Figure 9-2 Example A:	No error
Figure 9-2 Example B:	Peripheral fault
Figure 9-2 Example C:	Bus error



LED on or flashing at 0.5 Hz/2 Hz/4 Hz (on / slow / medium / fast)

Peripheral fault

Error:	Short circuit at terminal 4 (IB IL 24 DO 2-2A)
Effect:	
field multiplexer:	**UL** LED and **LE** LED are on (see Table 9-3, no. 12)
Opposite station:	**UL** LED is on, **LE** LED is flashing (see Table 9-3, no. 13)
Terminal 4:	**D** LED flashes at 2 Hz
Other terminals:	Remain unchanged
Alarm relay:	Not activated

Bus error

Error:	Local bus has been interrupted after terminal 3 and before terminal 4
Effect:	
field multiplexer:	**UL**, **ST** and **LE** LEDs are on (see Table 9-3, no. 7)
Opposite station:	**UL** and **ST** LEDs are on, **LE** LED is flashing (see Table 9-3, no. 7)
Terminal 4:	**D** LED flashing at 4 Hz (bus error)
Other terminals:	**D** LEDs on all other terminals flashing at 0.5 Hz *)
Alarm relay:	Activated

*) If the bus error is located on the forward path of the local bus, the devices before the fault location flash at 0.5 Hz. If the error is located on the return path, irregular flashing (switching off for short periods) can be observed on the LEDs of the devices before the fault location.

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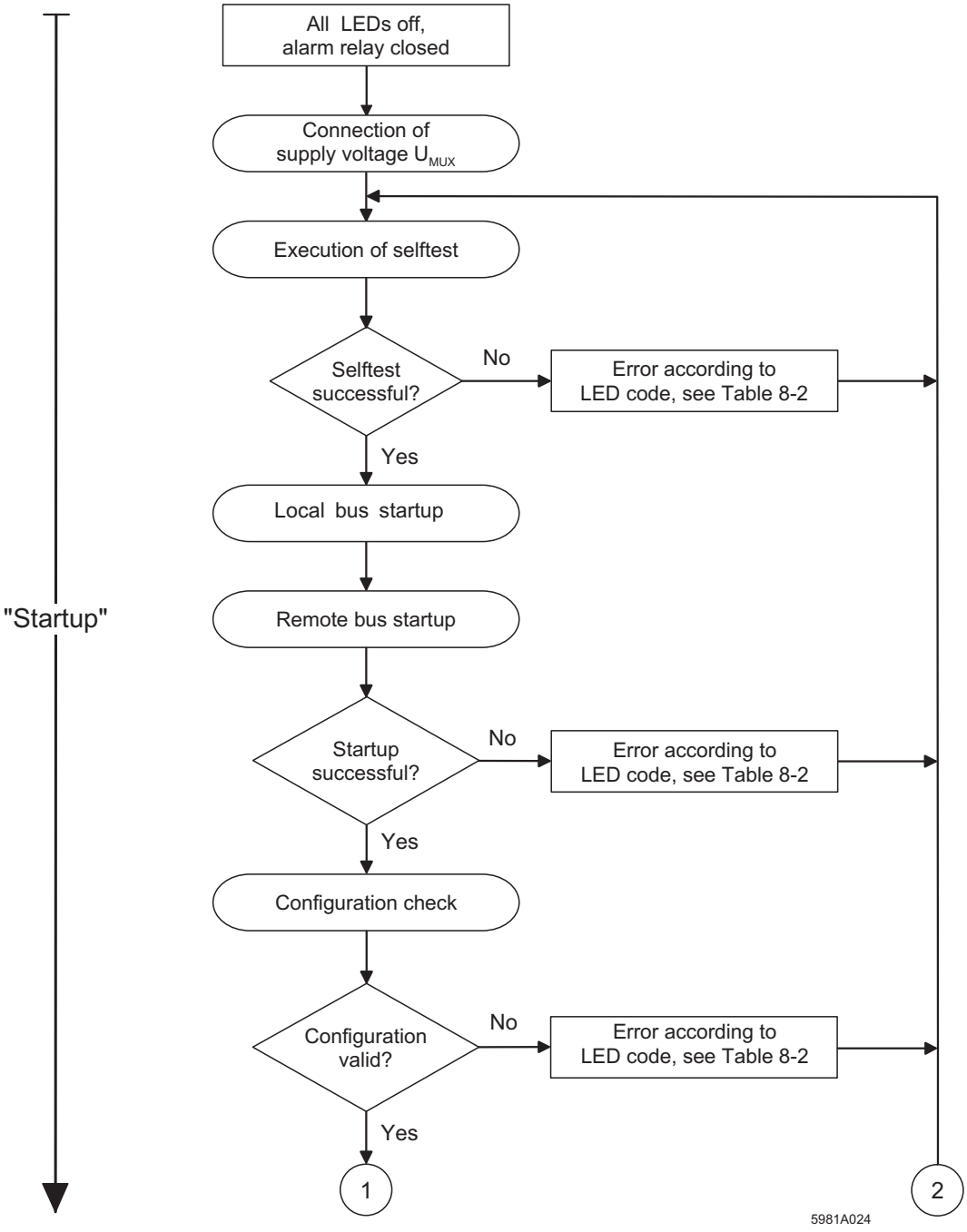
9.5 Flowchart

The following flowchart (Figure 9-3) supplements Sections 9.2 through 9.4. The most important states during startup and operation of the field multiplexer are listed briefly here.



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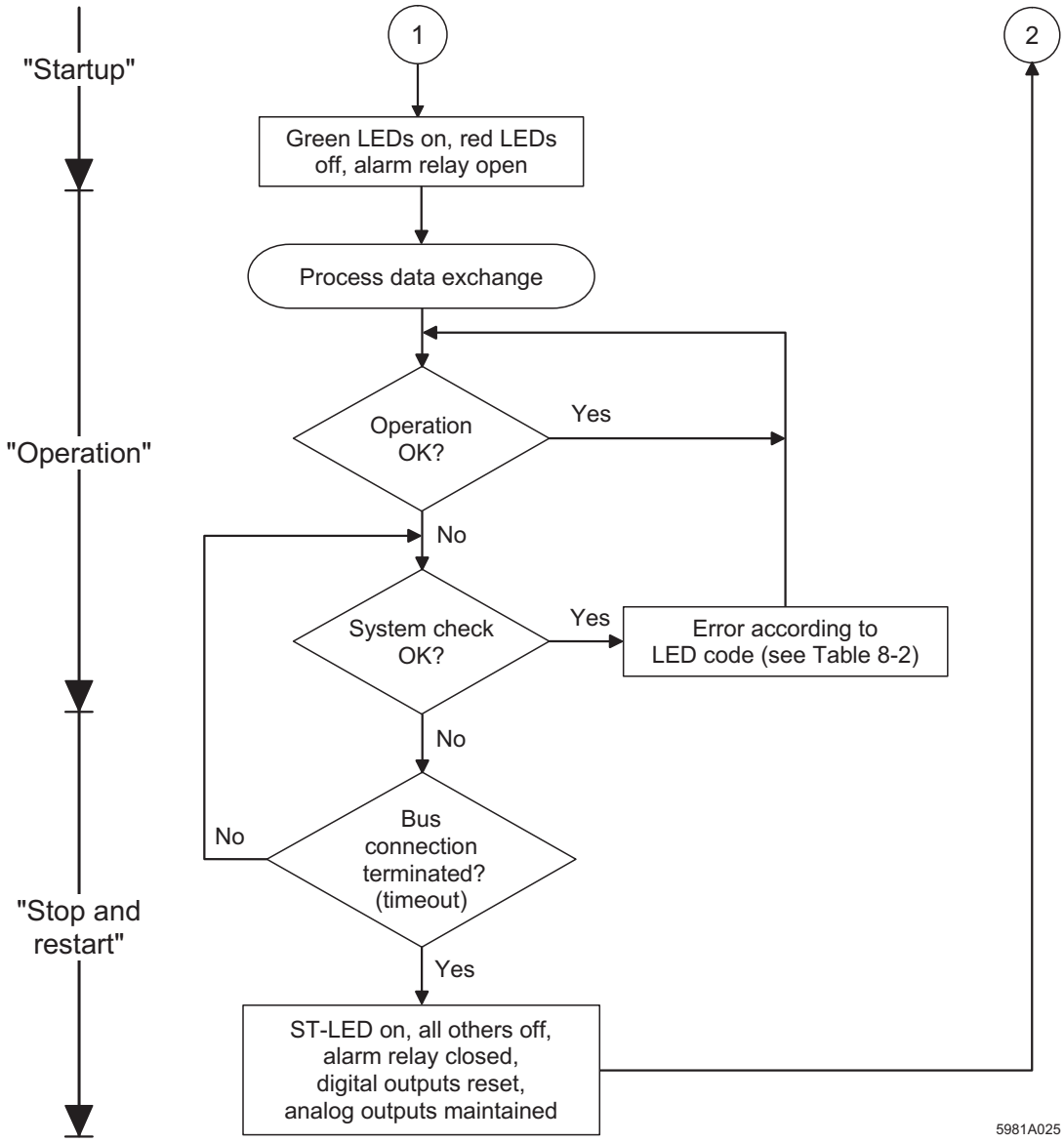

Figure 9-3 Operating states of the field multiplexer

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10 Technical data and ordering data

For technical data of the Inline system, please refer to the IL SYS INST UM E user manual.

Technical data on the Inline I/O terminals can be found in the terminal-specific data sheets.

10.1 Technical data of the field multiplexer

General data	
Housing dimensions (width x height x depth)	48.8 mm x 136 mm x 72 mm (with connector set)
Weight	146 g (without connectors), 212 g (with connectors)
Ambient temperatures (operation)	- 25°C ... + 55°C
Ambient temperature (storage)	- 25°C ... + 85°C
Humidity (operation/storage/transport)	10% ... 95% according to EN 61131-2
Air pressure (operation/storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20
Class of protection	Class 3 according to EN 61131-2, IEC 61131-2
Housing material	Basic material: ARNITE plastic PA6.6, self-extinguishing (V0)
Pollution degree according to EN 50178	2; condensation not permitted during operation
Surge voltage class	II (low-level signal)
Connection data for Inline connectors	
Connection method	Spring-cage terminals
Conductor cross-section	0.08 mm^2 to 1.5 mm^2 (solid or stranded), 28 - 16 AWG

System data	
Number of devices per station	63, maximum
Number of I/O points per station	512 digital or 32 analog I/Os, maximum, can be mixed
Update time of all inputs/outputs	1 s, maximum
Maximum field multiplexer current for supplying the logic of I/O terminals	2 A at U_L
Maximum current of the field multiplexer for supplying the analog terminals	0,5 A at U_{ANA}

Common data for 24 V main supply, segment supply, and field multiplexer supply	
Connection	Through Inline connector; terminal point assignment see page 4-4
Connection method	Spring-cage terminals
Recommended cable lengths	30 m, maximum; routing cables through outdoor areas is not permitted
Continuation	Via potential routing
Special demands on the power supply	The field multiplexer supply U_{MUX} is electrically isolated from U_M/U_S if it is supplied separately. This is only ensured if two separate power supplies are used.
Nominal value	24 V DC
Ripple	± 5%

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Common data for 24 V main supply, segment supply, and field multiplexer supply (contd.)

Permissible range	19.2 V to 30 V (ripple included)

NOTE: Module damage due to overload

Each 24 V area must be protected externally. The power supply unit must be able to supply 4 times (400%) the nominal current of the external fuse, to ensure that the fuse blows safely in the event of an error.

Observe the current consumption of every device on the individual potential jumpers when configuring a field multiplexer station. It is specified in every terminal-specific data sheet. The current consumption can differ depending on the individual terminal. If the maximum current carrying capacity of a potential jumper is reached, a new power terminal must be used.

24 V main supply (U_M)/24 V segment supply (U_S)

Current carrying capacity	8 A, maximum

WARNING: Explosion hazard, restrictions regarding the Inline system

When using the terminal in potentially explosive areas, observe the limitations on the current carrying capacity (see "Notes on using the terminal in potentially explosive areas" on page 2-1).

24 V field multiplexer supply (U_{MUX})

Current consumption at U_{MUX}	
Minimum current consumption at nominal voltage	60 mA (no local bus devices connected)
Maximum current consumption at nominal voltage	1.25 A
	Consisting of
	0.060 A Current consumption of field multiplexer, electronics
	+ 0.690 A Communications power for all I/O terminals
	+ 0.5 A Supply for the analog terminals

The field multiplexer supply U_{MUX} (24 V) generates the communications power U_L (7.5 V) and the analog supply U_{ANA} (24 V).

Communications power (U_L) and analog supply (U_{ANA})

Communications power (potential jumpers)

Nominal value	7.5 V DC
Maximum output current	2 A DC (observe derating)
Protective equipment	Electronic short-circuit protection

Analog supply (potential jumpers)

Nominal value	24 V DC
Maximum output current	0.5 A DC (observe derating)
Protective equipment	Electrical short-circuit protection

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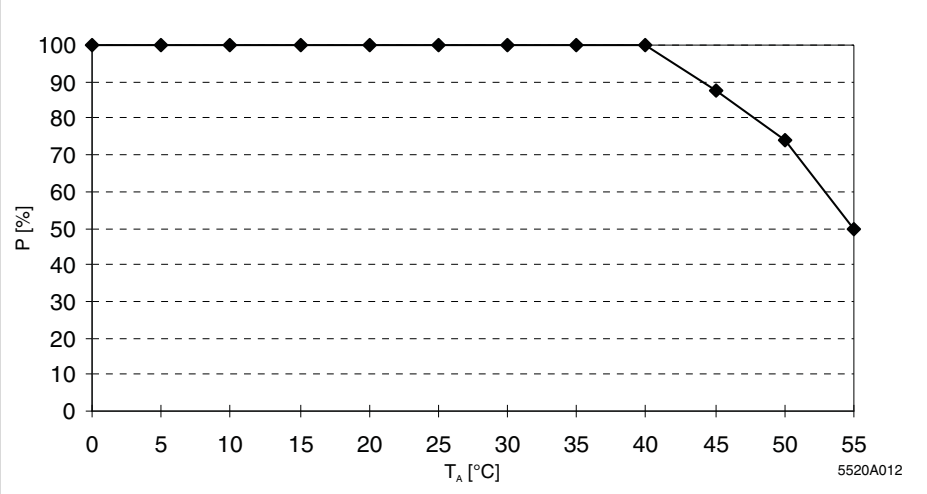
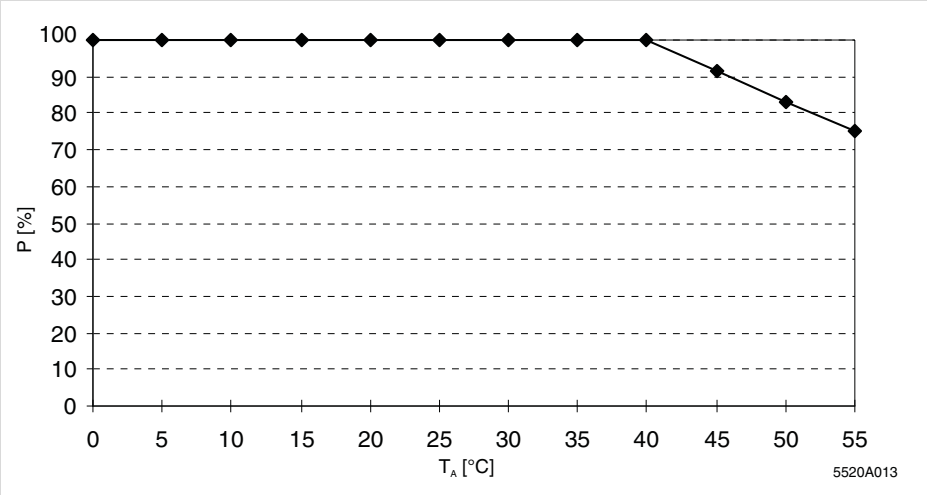
Derating of the communications power and the analog terminal supply

- I/O supply with a current carrying capacity at the field multiplexer of 8 A, maximum



P [%]	Current carrying capacity of the communications power (U_L) and the analog supply (U_{ANA}) in %
T_A [°C]	Ambient temperature in °C

- I/O supply with a current carrying capacity at the field multiplexer of 4 A, maximum



P [%]	Current carrying capacity of the communications power (U_L) and the analog supply (U_{ANA}) in %
T_A [°C]	Ambient temperature in °C

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Protective equipment

Surge voltage (segment supply U_S/main supply U_M/field multiplexer supply U_{MUX})	Input protective diodes (can be destroyed by permanent overload) Pulse loads up to 1500 W are short circuited by the input protective diode.
Polarity reversal (segment supply U_S/main supply U_M)	Parallel diodes for protection against polarity reversal; in the event of an error the high current through the diodes causes the preconnected fuse to blow.
Polarity reversal (field multiplexer supply U_{MUX})	Serial diode in the lead path of the power supply; in the event of an error only a low current flows. In the event of an error, no fuse trips within the external power supply. Ensure 2 A fuse protection to the external power supply.

The field multiplexer supply is protected against polarity reversal and surge voltage. These protective elements are only used to protect the power supply unit.

Electrical isolation

RS-485 interface/supply voltage	500 V AC
RS-485 interface/local bus	500 V AC

Interfaces

Remote bus	
Connection	Inline shield connector
Interface type	RS-485, modified
Transmission protocol	Special remote control protocol
Remote bus length (copper)	12 km, maximum and 5 km, typical (depending on cable type and EMC environmental conditions)
Remote bus length (fiber optic)	Using fiber optic converters
– Polymer fiber	Up to 100 m
– HCS fiber	Up to 2400 m
– Multi-mode glass fiber	Up to 25 km
– Single-mode glass fiber	Up to 45 km
Local bus	
Connection	Inline data routing

Local functions

Alarm output (floating contacts)	N/C relay contact for 24 V DC/1 A, typical Maximum contact power: 30 W DC or 60 VA AC Maximum contact voltages: 150 V DC or 125 V AC (A maximum switching current of 1 A must not be exceeded)

Observe high inrush currents when using lamps as alarm signals. Phoenix Contact recommends avoiding lamp loads greater than 24 V/40 mA.

Mechanical requirements

Vibration (operation)	2g, according to IEC 60068-2-6, criterion 1
Vibration (storage)	2g, according to IEC 60068-2-6
Shock (operation)	15g, according to IEC 60068-2-27, criterion 2

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Conformance with EMC directive 2004/108/EC

Noise immunity test according to DIN EN 61000-6-2

Electrostatic discharge (ESD)	EN 61000-4-2/ IEC 61000-4-2	Criterion B 6 kV contact discharge 8 kV air discharge
Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	Criterion A Field strength: 10 V/m
Fast transients (burst)	EN 61000-4-4/ IEC 61000-4-4	Criterion A All interfaces: 1 kV
Surge voltage	EN 61000-4-5/ IEC 61000-4-5	Criterion B DC supply lines: 0.5 kV/0.5 kV (symmetrical/asymmetrical) Signal cables: 1.0 kV/2.0 kV (symmetrical/asymmetrical)
Conducted interference	EN 61000-4-6 IEC 61000-4-6	Criterion A Test voltage 10 V

Noise emission test according to EN 61000-6-4

Noise emission of housing	EN 55011	Class A

Approvals

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10.2 Ordering data

Products

Description	Type	Order No.	Pcs./Pkt.
Inline field multiplexer, complete with accessories (connectors and labeling fields)	IB IL MUX MA-PAC	2861205	1
Inline field multiplexer, without accessories	IB IL MUX	2718413	1

The listed connector set is needed for the complete fitting of the IB IL MUX.

Accessories

Description	Type	Order No.	Pcs./Pkt.
Connector set for the field multiplexer	IB IL MUX-PLSET	2836036	1
Keying profile	CP-MSTB see COMBICON catalog	2742683	100
Zack marker strip to label the terminals	ZBF 6 ... see CLIPLINE catalog ZBF 12 ... see CLIPLINE catalog		
DIN EN 50022 DIN rail, 2 meters	NS 35/7,5 PERFORATED NS 35/7,5 UNPERFORATED	0801733 0801681	
Standard end clamp; snapped on without tools	CLIPFIX 35-5	3022276	50
End clamp for use in the event of vibrations or installation on vertical DIN rail; secured with screws	E/AL-NS 35	1201662	50
Universal ground terminal block	USLKG 5	0441504	
Remote bus cable to connect the field multiplexer stations (sold by the meter)	IBS RBC METER-T	2806286	
field multiplexer adapter cable to interface converter	IB IL MUX-CAB PSI	2878476	1
Screwdriver according to DIN 5264, blade width 3.5 mm	SZF 1 - 0,6 x 3,5	1204517	

For a list of Inline terminals approved for use on the field multiplexer including the corresponding ordering numbers, please refer to the AH IL BK IO LIST application note, Order No. 9015358.

Accessories: Additional system components

Description	Type	Order No.	Pcs./Pkt.
Surge protection for protection of the remote bus cable, the power supply units, and the entire control cabinet by fuses	See TRABTECH catalog		
Fiber optic converters for fiber optic data transmission	See INTERFACE catalog See also Section "Transmission over fiber optics" on page A-3		
RS-232/RS-485 converter for data transmission over telephone lines	See INTERFACE catalog See also Section "Transmission over telephone line (modem)" on page A-7		
Bluetooth converter for data transmission over Bluetooth	See INTERFACE catalog See also Section "Transmission over Bluetooth (wireless)" on page A-15		
Ethernet converter for data transmission over Ethernet	See INTERFACE catalog See also Section "Transmission over Ethernet (COM SERVER)" on page A-33		
Temperature measuring transducer to acquire temperature values	See INTERFACE catalog		

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Accessories: Additional system components

Description	Type	Order No.	Pcs./Pkt.
Power supply units to supply the field multiplexer stations	See INTERFACE catalog		
End clamps, grounding clamps, and shield connection clamps	See CLIPLINE catalog		
Cables suitable for copper or fiber optic transmission	See INTERFACE or AUTOMATION catalog		

Documentation

Description	Type	Order No.	Pcs./Pkt.
"Automation terminals of the Inline product range" user manual	IL SYS INST UM E	2698737	1
"Summary of key data for Inline devices" data sheet	DB GB IB IL DEVICE LIST	9007007	1
"I/O modules at bus couplers" application note	AH BK IO LIST	9015358	1
"Inline terminals for use in zone 2 potentially explosive areas" application note	AH EN IL EX ZONE 2	–	–

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A Technical appendix: The field multiplexer with different transmission media

The following sections describe a quick startup of the field multiplexer system when different transmission media are used.

Further information can be found in the documentation for the products used. It can be downloaded from www.download.phoenixcontact.com.

A 1 Transmission over copper cable

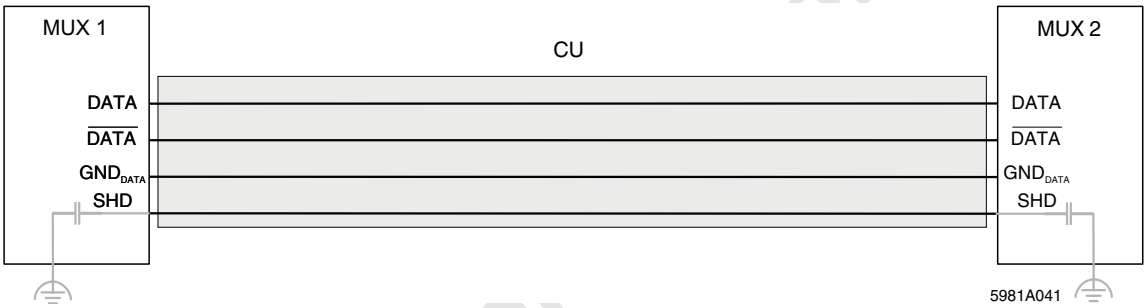

Figure A-1 Basic circuit diagram: Transmission over copper cable

Key:

MUX	IB IL MUX MA-PAC
CU	Copper cable, for example, IBS RBC METER-T from Phoenix Contact

No jumper must be installed from 1.1 to 2.1 ($CONF_{FO}$) on connector 1 of both field multiplexers.

When a field multiplexer system is being installed for the first time, Phoenix Contact recommends a 3-wire shielded cable. In this case, connector1 of both stations should be connected to the DATA, $\overline{DATA}$, and GND_{DATA} signals and the shield (see also Section "Terminal point assignment" on page 4-4). DATA and $\overline{DATA}$ should additionally be a twisted pair.

Laying the remote bus cable

When laying the remote bus cable, note the following:

- Do not lay signal and bus cables in parallel to power cables
- If possible, lay remote bus cables and cables with voltages of 230 V and above in separate cable ducts
- Always lay signal leads and equipotential bonding together in one cable following the shortest route
- Avoid extending the remote bus cables with connecting plugs

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Phoenix Contact recommends the remote bus cable IBS RBC METER-T (Order No. 2806286, see also Section "Ordering data" on page 10-6 or the AUTOMATION catalog).

If you require further information on the selection of suitable remote bus cables, please contact Phoenix Contact.

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A 2 Transmission over fiber optics

This section describes the configuration of an Inline field multiplexer station with a fiber optic path using the fiber optic converters PSI-MOS-RS485W2/FO...

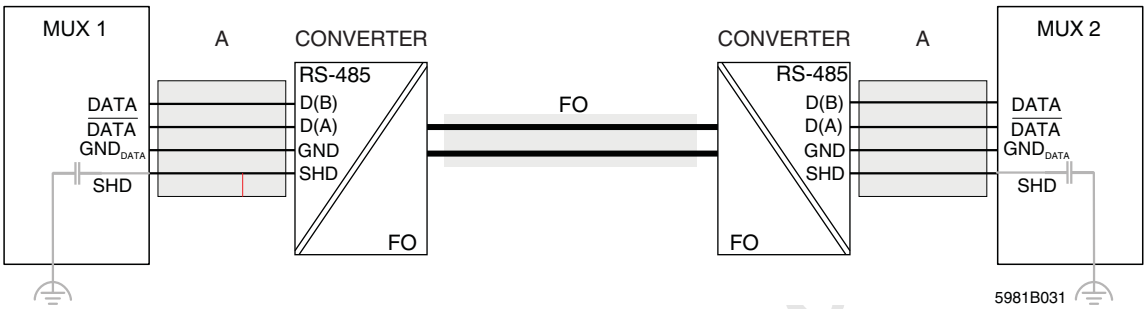

Figure 10-1 Basic circuit diagram: Transmission over fiber optics

Key:

MUX	IB IL MUX MA-PAC
A	Adapter cable; IB IL MUX-CAB PSI
CONVERTER	Fiber optic converter, see Section "PSI-MOS-RS485W2/FO... fiber optic converters that can be used" on page A-4
FO	Remote bus cable (glass fiber/HCS)

A 2.1 Devices for the field multiplexer station

Table A-1 Devices that can be used

Type	Type	Order No.	Number
Field multiplexer	IB IL MUX MA-PAC	2861205	2
Fiber optic converters	PSI-MOS-RS485W2/FO...	See Section A 2.2	2
Adapter cable	IB IL MUX-CAB PSI	2878476	2

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A 2.2 PSI-MOS-RS485W2/FO... fiber optic converters that can be used

The fiber optic converters are available for both glass fiber and for HCS fiber cables in different performance classes. The appropriate ordering data can also be found in the INTERFACE catalog from Phoenix Contact.

Table A-2 Fiber optic converters (with one fiber optic interface)

Order Designation	Order No.	Cable type used	Distance
PSI-MOS-RS485W2/FO 660 E	2708313	POF	Up to 100 m
		HCS/PCF	Up to 800 m
PSI-MOS-RS485W2/FO 850 E	2708339	HCS/PCF	Up to 2800 m
		Multi-mode glass fiber	Up to 4200 m
PSI-MOS-RS485W2/FO 1300 E	2708562	Multi-mode glass fiber	Up to 25 km
		Single-mode glass fiber	Up to 45 km

Table A-3 Fiber optic converters (T coupler with two fiber optic interfaces)

Order Designation	Order No.	Cable type used	Distance
PSI-MOS-RS485W2/FO 660 T	2708300	POF	Up to 100 m
		HCS/PCF	Up to 800 m
PSI-MOS-RS485W2/FO 850 T	2708326	HCS/PCF	Up to 2800 m
		Multi-mode glass fiber	Up to 4200 m

A 2.3 Basic field multiplexer settings

- Set the same transmission mode (FO) on both field multiplexers.
  To do so, insert **a jumper** from 1.1 to 2.1 ($CONF_{FO}$) at connector 1 (see also Figure 8-3 on page 8-12).
- Configure one field multiplexer station as master and the other one as slave (see Section "Configuring the station as a master or a slave" on page 4-8).

You will find the additional terminal point assignment of the field multiplexer in Section "Terminal point assignment" on page 4-4.

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A 2.4 Configuring fiber optic converters

Both fiber optic converters

- Please make the following settings at the fiber optic converters:
  - Transmission speed: 75 kbps
  - Telegram length: 11 bits
  - Light idle position: INVERSE
  - Echo evaluation (660 nm and 850 nm devices only): OFF
  - Termination resistor: ON
  - Other settings according to the application

Table A-4 Configuration of the converters using DIP switches

DIP switch	Position	Meaning
1	OFF	Transmission speed 75 kbps
2	ON	
3	ON	
4	OFF	
5	OFF	Telegram length 11 bits

NOTE: Malfunction

When connecting two optical fiber converters, pay attention to the signal direction of the optical fiber. Connect the TD (sender) fiber connection of the first converter with the RD (receiver) fiber connection of the second converter.

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A 2.5 Connecting the cables

Table A-5 Connection between converter and field multiplexer

Converter PSI-MOS-RS485W2/FO...		Field multiplexer IB IL MUX MA-PAC		
Terminal point	**Signal**	**Connector 1, Terminal point**	**Signal**	**Color**
5	Shield	1.4 / 2.4	Shield	–
6	GND	1.3	GND	Gray
7	Data positive D(B)	1.2	Data	Yellow
8	Data negative D(A)	2.2	/Data	Green

Phoenix Contact offers a pre-assembled adapter cable as an optional accessory for the connection from the PSI-MOS-RS485W2/FO... converter to the IB IL MUX MA-PAC: IB IL MUX-CAB PSI.

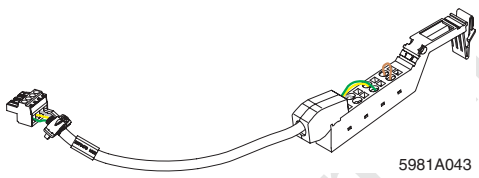

Figure A-2 IB IL MUX-CAB PSI cable

NOTE: Malfunction

If you assemble the adapter cable for the connection between field multiplexer and interface converter by yourself: Please make sure that the cable is not longer than 1 m.

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A 3 Transmission over telephone line (modem)

This section describes the configuration of an Inline field multiplexer station with a telephone line path using the RS-232/RS-485 converters PSM-ME-RS232/RS485-P and PSI-DATA/FAX-MODEM/RS232 modems.

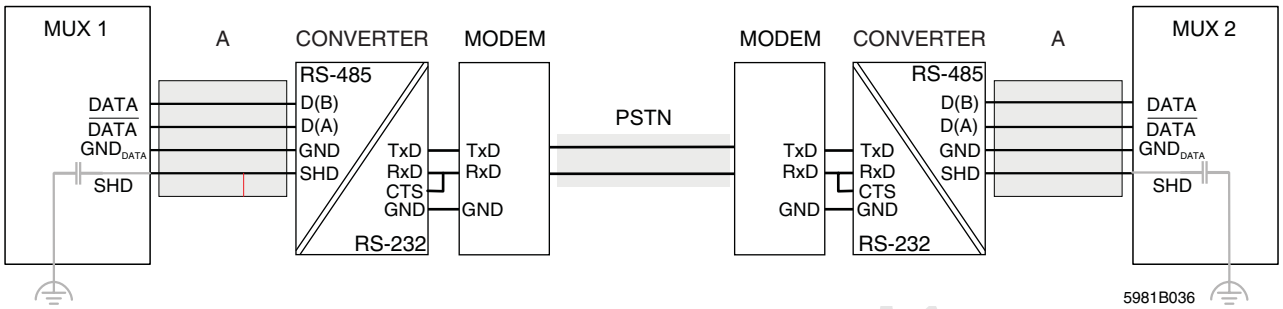

Figure A-3 Basic circuit diagram: Transmission over telephone line

Key:

MUX	IB IL MUX MA-PAC
A	Adapter cable
CONVERTER	RS232/RS485 converter: PSM-ME-RS232/RS485-P
MODEM	Modem: PSI-DATA/FAX-MODEM/RS232
PSTN	2-wire telephone line (Public Switched Telephone Network)

A detailed wiring examples is shown in Figure A-4 on page A-13.

A 3.1 Devices and software for the field multiplexer station

Table A-6 Devices and software that can be used

Description	Type	Order No.	Number
Field multiplexer	IB IL MUX MA-PAC	2861205	2
Modem	PSI-DATA/FAX-MODEM/RS232	2708203	2
RS232/RS485 converter	PSM-ME-RS232/RS485-P	2744416	2
D-SUB male connector, 9-pos.	SUBCON 9/F-SH	2761499	4
Software for modem	PSI-MODEM-CONF V3.0 or later (software on CD)		1

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A 3.2 Basic field multiplexer settings

- Configure one field multiplexer station as master and the other one as slave (see Section "Configuring the station as a master or a slave" on page 4-8).

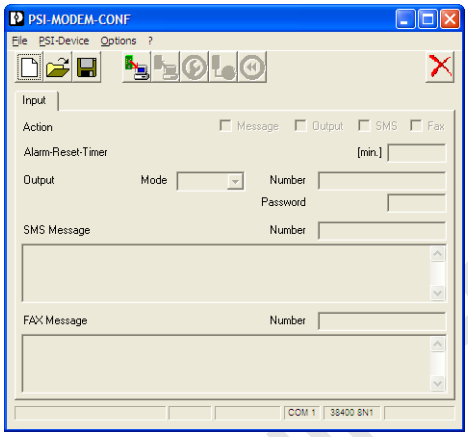
No jumper must be installed from 1.1 to 2.1 ($CONF_{FO}$) on connector 1 of both field multiplexers.

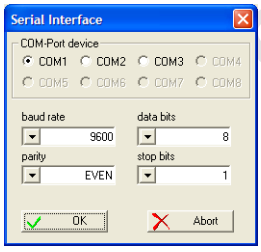
You will find the additional terminal point assignment of the field multiplexer in Section "Terminal point assignment" on page 4-4.

A 3.3 Configuring modems using software

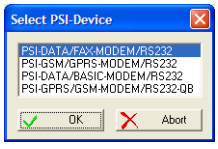
First modem

- Connect the modem and the PC via a serial 1:1 cable and supply it with 24 V DC.
- Start the PSI-MODEM-CONF configuration software on the PC.
- Select "Options, RS232" in the pulldown menu.





- Select the COM port (e.g., COM1) in the "Serial Interface" window.
- Set the following parameters for the serial interface:
  - Baud rate: 9600 bps
  - Data bits: 8;
  - Parity: Even
  - Stop bits: 1
- Store the settings with "OK".
- Open a new configuration. To do so, select "File, New" in the pulldown menu or click the "New" button.
- Select the PSI-DATA/FAX-MODEM/RS232 modem and confirm with "OK".



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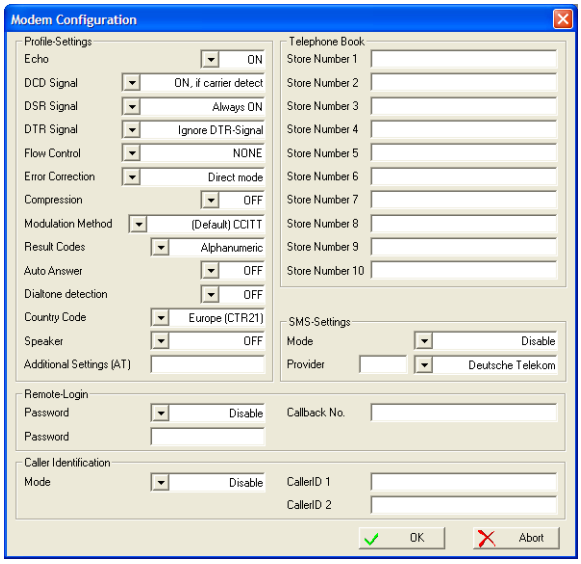

- Edit the modem profile. Select "PSI device, Edit profile" in the pulldown menu or click the "Edit profile" button.
- Set the following parameters in the "Modem Configuration" window and confirm the settings with "OK".
  - DTR Signal: Ignore DTR Signal
  - Flow Control: NONE
  - Error Correction: Direct mode
  - Compression: OFF

- Transfer the configuration to the modem. Select "PSI device, Write configuration" in the pulldown menu or click the "Transfer configuration" button.
- The first modem is now configured. Select "File, Exit" or click the "Exit program" button.

Second modem

- Configure the second modem. For the configuration, proceed as described for the first modem.

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A 3.4 Setting the DIP switches of the modems

First modem

- Open the protective cover of the modem. Insert a small screwdriver into the slot at the bottom of the cover and lever it open.
- Set the DIP switches of the first modem according to Table A-7.

Table A-7 Setting the DIP switches of modem 1

DIP switch	Function	Setting
1	Permanent line	ON
2	Fixed at 7200 bps	ON
3	Originate Mode	ON
4	Device Settings	OFF

- Close the protective cover and execute a cold start (24 V OFF and ON).

Second modem

- Open the protective cover of the modem. Insert a small screwdriver into the slot at the bottom of the cover and lever it open.
- Set the DIP switches of the modem according to Table A-8.

Table A-8 Setting the DIP switches of modem 2

DIP switch	Function	Setting
1	Permanent line	ON
2	Fixed at 7200 bps	ON
3	Answer Mode	OFF
4	Device Settings	OFF

- Close the protective cover and execute a cold start (24 V OFF and ON).

Further information on the configuration and connection of modems can be found in the associated documentation.

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A 3.5 Configuring the converters

First converter

- Release the housing cover of the RS-232/RS-485 converter on the left and right and pull the housing cover with the printed circuit board out of the base element as far as possible.
- Set the interface converter using the internal DIP switches.

Table A-9 DIP switches of the interface converter

DIP switch	Function	Setting
1	Transmission speed of 9600 bps	ON
2		OFF
3		ON
4		ON
5	RTS/CTS control	ON
6	RTS/CTS signal inverted	ON
7	2-wire interface	OFF
8	RS-485	OFF

- Activate the bus termination by switching the "Terminate" slide switch to the ON position.
- Set the DTE/DCE slide switch to DCE.
- Push the housing cover into the base element until it locks

Second converter

- Enter the settings for the second RS-232/RS-485 converter as well.

Both converters

- Execute a cold restart on both RS-232/RS-485 converters (24 V ON).

Further information on the configuration and connection of interface converters can be found in the associated documentation.

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A 3.6 Connecting the cables

- Connect one modem with the RS-232 side of an RS-232/RS-485 converter using a special 3-position SUB-D9 cable and the SUBCON 9/F-SH connectors (see Table A-10).

Table A-10 Connection between converter and modem

Converter PSM-ME-RS232/RS485-P		Modem PSI-DATA/FAX-MODEM/RS232	
Signal	**SUBCON 9/F-SH, Pin**	**SUBCON 9/F-SH, Pin**	**Signal**
Shield	Strain relief	Strain relief	Shield
CTS	8		
GND	5	5	GND
TxD	3	3	TxD
RxD	2	2	RxD
	Jumper pin 8 and pin 2		

- Assemble the adapter cable for the connection between field multiplexer and interface converter. For the terminal point assignment, please refer to Table A-11.

NOTE: Malfunction
Please make sure that the cable is not longer than 1 m.

Table A-11 Connection between converter and field multiplexer

Converter PSM-ME-RS232/RS485-P		field multiplexer IB IL MUX MA-PAC		
Signal	**Terminal point**	**Connector 1, Terminal point**	**Signal**	**Color**
Shield	8	1.4 / 2.4	Shield	–
GND	6	1.3	GND	Gray
Data + (B)	2	1.2	Data	Yellow
Data - (A)	1	2.2	/Data	Green

- Connect one field multiplexer with the RS-485 side of an RS-232/RS-485 converter.

A wiring example is shown in Figure A-4.

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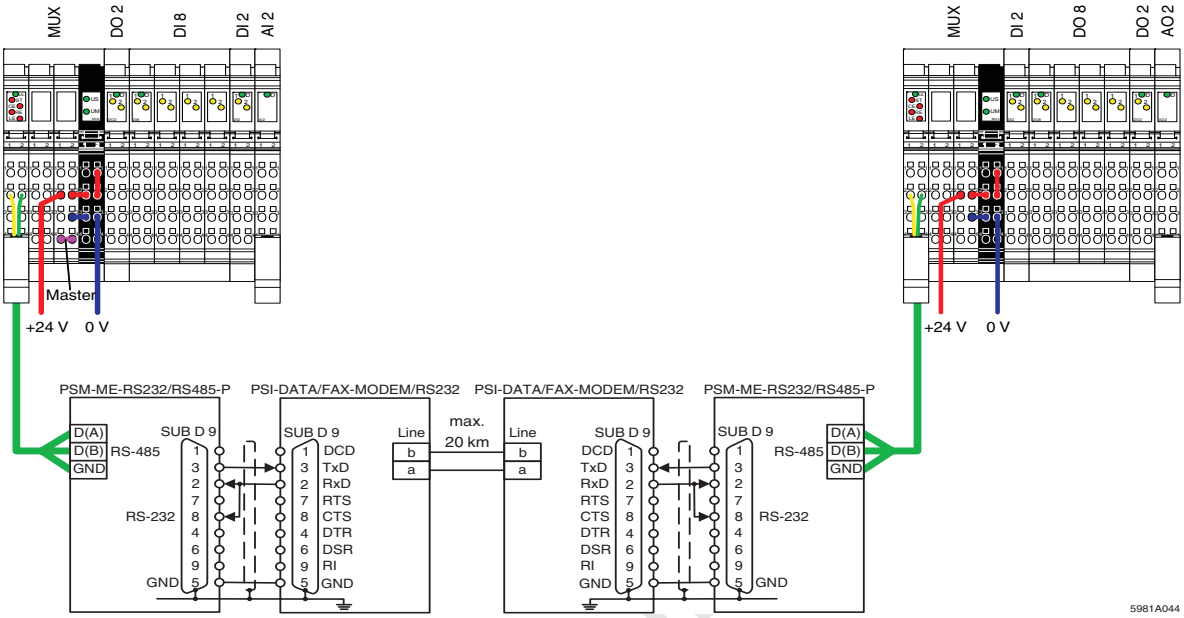

Figure A-4 Wiring example

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A 4 Transmission over Bluetooth (wireless)

This section describes the configuration of an Inline field multiplexer station with a Bluetooth path using the Bluetooth converters PSI-WL-RS232-RS485/BT.

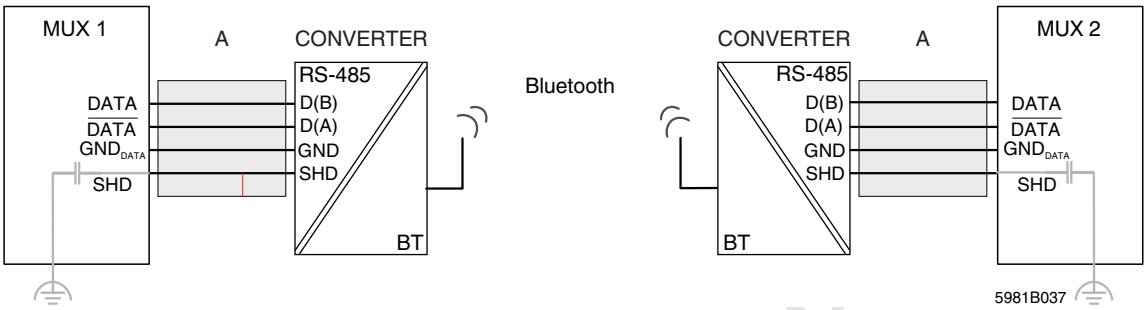

Figure A-5 Basic circuit diagram: Transmission over Bluetooth

Key:

MUX	IB IL MUX MA-PAC
A	Adapter cable
CONVERTER	Bluetooth converter: PSI-WL-RS232-RS485/BT
Bluetooth	Bluetooth connection

NOTE: Malfunction

In combination with the PSI-WL-RS232-RS485/BT converter, up to **50 digital and two analog signals** can be transmitted.

A 4.1 Devices and software for the field multiplexer station

Table A-12 Devices and software that can be used

Type	Type	Order No.	Number
Field multiplexer	IB IL MUX MA-PAC	2861205	2
Bluetooth converter	PSI-WL-RS232-RS485/BT	2708517	2
Required for configuration of the converters			
RS-232 cable, 9-pos. SUB-D female connector to 9-pos. SUB-D female connector	PSM-KA9SUB9/BB/2METER	2799474	1 or 2
Converter software	PSI-BLUETOOTH-CONF V2.40 (software on CD)		1

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A 4.2 Basic field multiplexer settings

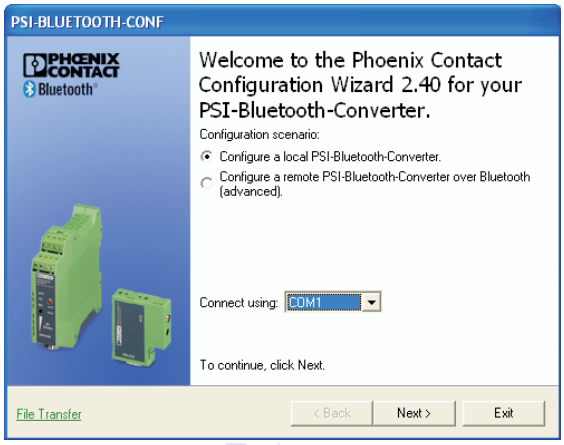
- Configure one field multiplexer station as master and the other one as slave (see Section "Configuring the station as a master or a slave" on page 4-8).

No jumper must be installed from 1.1 to 2.1 ($CONF_{FO}$) on connector 1 of both field multiplexers.

You will find the additional terminal point assignment of the field multiplexer in Section "Terminal point assignment" on page 4-4.

A 4.3 Setting the Bluetooth server (first Bluetooth converter)

- Connect the first Bluetooth converter and the PC via a serial 1:1 cable and supply it with 24 V DC.
- Open the Bluetooth converter housing and switch the CONF/RUN switch to CONF mode.
- Start the PSI-BLUETOOTH-CONF configuration software on the PC.
- Select the communication interface (e.g., COM1) and confirm with "Next".



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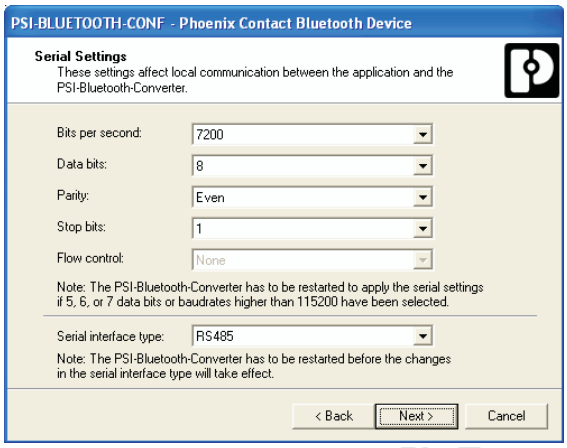
The basic menu of the configuration wizard opens.

- Select "Serial settings" and confirm with "Next".


PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Serial Settings
These settings affect local communication between the application and the PSI-Bluetooth-Converter.
Bits per second:
7200
Data bits:
8
Parity:
Even
Stop bits:
1
Flow control:
None
Note: The PSI-Bluetooth-Converter has to be restarted to apply the serial settings if 5, 6, or 7 data bits or baudrates higher than 115200 have been selected.
Serial interface type:
RS485
Note: The PSI-Bluetooth-Converter has to be restarted before the changes in the serial interface type will take effect.
< Back
Next >
Cancel

- Set the parameters specified for the serial interface and confirm with "Next".
  - Transmission speed: 7200 bps
  - Data bits: 8
  - Parity: Even
  - Stop bits: 1
  - Serial interface: RS485

- Select "Bluetooth general settings" in the basic menu and confirm with "Next".

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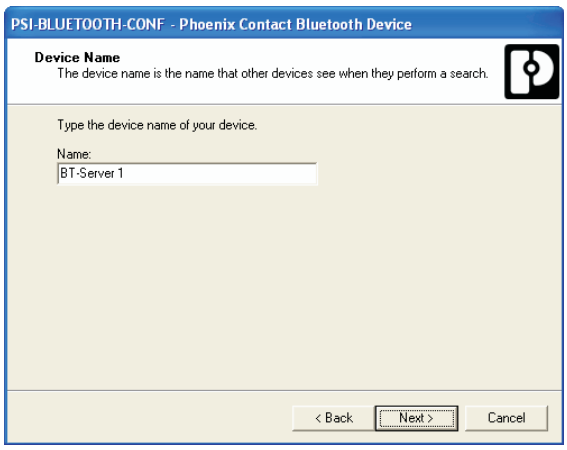
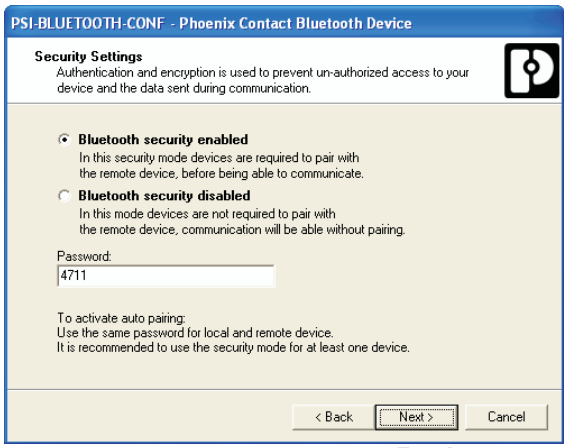

PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Device Name
The device name is the name that other devices see when they perform a search.
Type the device name of your device.
Name:
BT-Server 1
< Back
Next >
Cancel

- Enter a Bluetooth device name and confirm with "Next".

The name must be unique for every Bluetooth converter and should refer to the technological unit.


PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Security Settings
Authentication and encryption is used to prevent un-authorized access to your device and the data sent during communication.
Bluetooth security enabled
In this security mode devices are required to pair with the remote device, before being able to communicate.
Bluetooth security disabled
In this mode devices are not required to pair with the remote device, communication will be able without pairing.
Password:
4711
To activate auto pairing:
Use the same password for local and remote device.
It is recommended to use the security mode for at least one device.
< Back
Next >
Cancel

- Select the "Bluetooth security enabled" option, enter a password (e.g., 4711), and confirm with "Next".

PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Operation Mode
The operation mode affects whether or not your PSI-Bluetooth-Converter can be connected to and discovered by other devices.
Non connectable
Other devices cannot connect to your device. Other devices cannot find your device by performing a search.
Connectable
Other devices can connect to your device. Other devices cannot find your device by performing a search.
Connectable and discoverable
Other devices can connect to your device and other devices can find your device by performing a search.
< Back
Next >
Cancel

- To keep the Bluetooth converter discoverable and connectable, select the "Connectable and discoverable" option and confirm with "Next".

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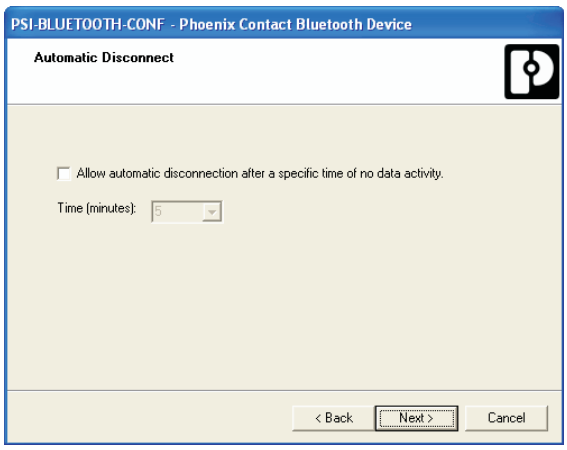
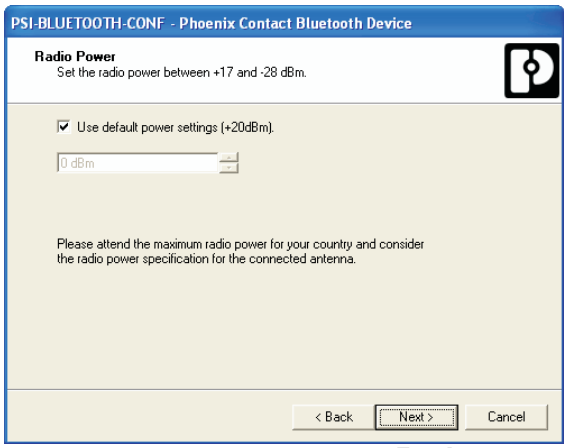
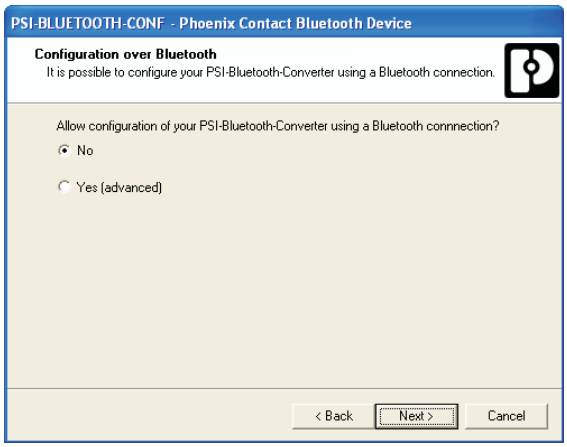


- In the "Automatic Disconnect" window disable the "Allow automatic disconnection" option and confirm with "Next".


PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Radio Power
Set the radio power between +17 and -28 dBm.
Use default power settings (+20dBm).
0 dBm
Please attend the maximum radio power for your country and consider the radio power specification for the connected antenna.
< Back
Next >
Cancel

- In the "Radio Power" window select the "Use default power settings" option and confirm with "Next".


PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Configuration over Bluetooth
It is possible to configure your PSI-Bluetooth-Converter using a Bluetooth connection.
Allow configuration of your PSI-Bluetooth-Converter using a Bluetooth connnection?
No
Yes (advanced)
< Back
Next >
Cancel

- In the "Configuration over Bluetooth" window select the "No" option, confirm with "Next", and store the settings with "Save".

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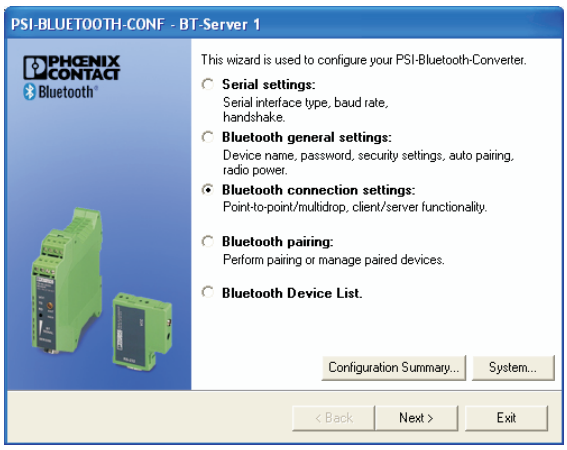
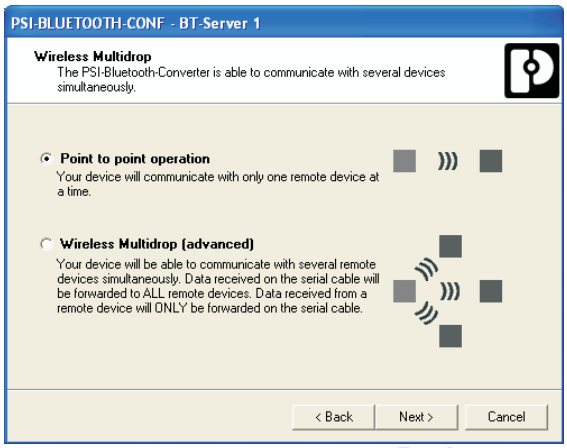
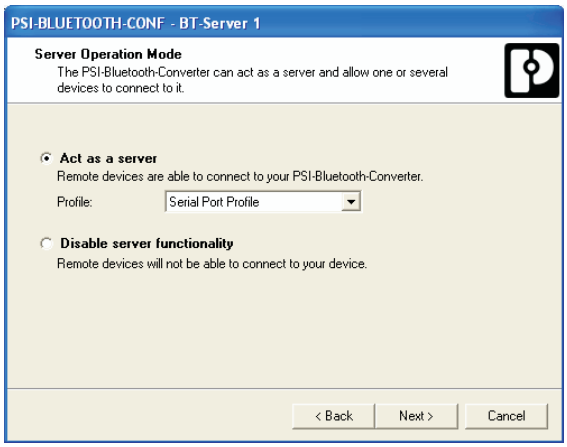


- Select "Bluetooth connection settings" in the basic menu and confirm with "Next".


PSI-BLUETOOTH-CONF - BT-Server 1
Wireless Multidrop
The PSI-Bluetooth-Converter is able to communicate with several devices simultaneously.
Point to point operation
Your device will communicate with only one remote device at a time.
Wireless Multidrop (advanced)
Your device will be able to communicate with several remote devices simultaneously. Data received on the serial cable will be forwarded to ALL remote devices. Data received from a remote device will ONLY be forwarded on the serial cable.
< Back
Next >
Cancel

- In the "Wireless Multidrop" window select the "Point to point operation" option and confirm with "Next".


PSI-BLUETOOTH-CONF - BT-Server 1
Server Operation Mode
The PSI-Bluetooth-Converter can act as a server and allow one or several devices to connect to it.
Act as a server
Remote devices are able to connect to your PSI-Bluetooth-Converter.
Profile:
Serial Port Profile
Disable server functionality
Remote devices will not be able to connect to your device.
< Back
Next >
Cancel

- In the "Server Operation Mode" window select the "Act as a server" option and the "Serial Port Profile", then confirm with "Next".

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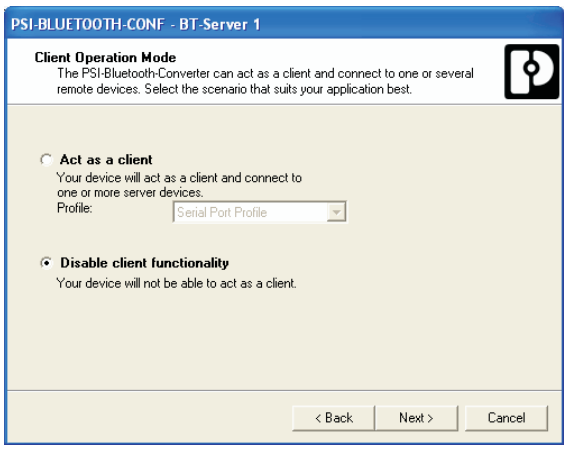
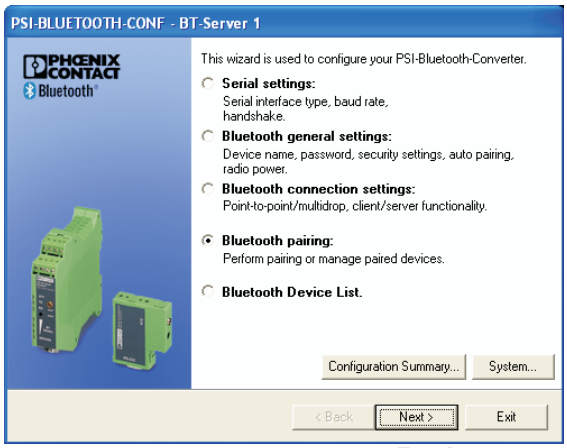
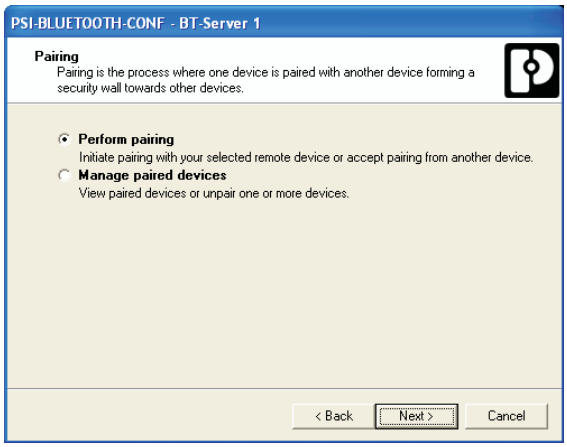

PSI-BLUETOOTH-CONF - BT-Server 1
Client Operation Mode
The PSI-Bluetooth-Converter can act as a client and connect to one or several remote devices. Select the scenario that suits your application best.
Act as a client
Your device will act as a client and connect to one or more server devices.
Profile:
Serial Port Profile
Disable client functionality
Your device will not be able to act as a client.
< Back
Next >
Cancel

- In the "Client Operation Mode" window select the "Disable client functionality" option, confirm with "Next", and store the settings with "Save".



- Select "Bluetooth pairing" in the basic menu and confirm with "Next".


PSI-BLUETOOTH-CONF - BT-Server 1
Pairing
Pairing is the process where one device is paired with another device forming a security wall towards other devices.
Perform pairing
Initiate pairing with your selected remote device or accept pairing from another device.
Manage paired devices
View paired devices or unpair one or more devices.
< Back
Next >
Cancel

- In the "Pairing" window select the "Perform pairing" option and confirm with "Next".

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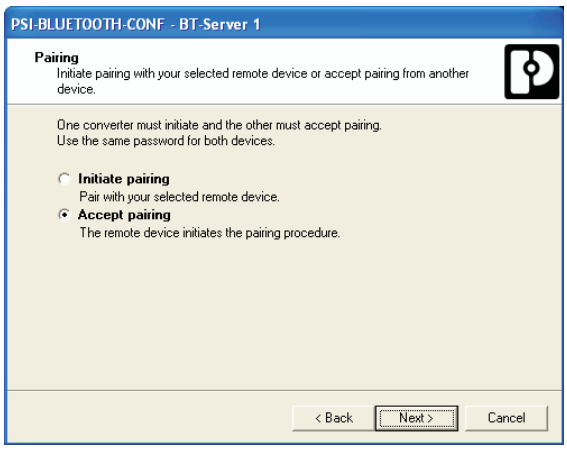
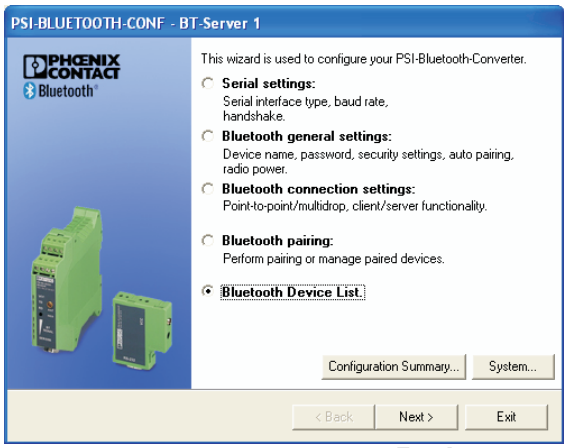

PSI-BLUETOOTH-CONF - BT-Server 1
Pairing
Initiate pairing with your selected remote device or accept pairing from another device.
One converter must initiate and the other must accept pairing.
Use the same password for both devices.
Initiate pairing
Pair with your selected remote device.
Accept pairing
The remote device initiates the pairing procedure.
< Back
Next >
Cancel

- In the "Pairing" window select the "Accept pairing" option, confirm with "Next", and store the settings with "Save".



- The Bluetooth server is now configured. Close the configuration software with "Exit".

- Switch the CONF/RUN switch in the device back to RUN mode. Close the Bluetooth converter.
- Remove the serial 1:1 cable from the first Bluetooth converter.
- Restart the Bluetooth converter (24 V OFF/ON).

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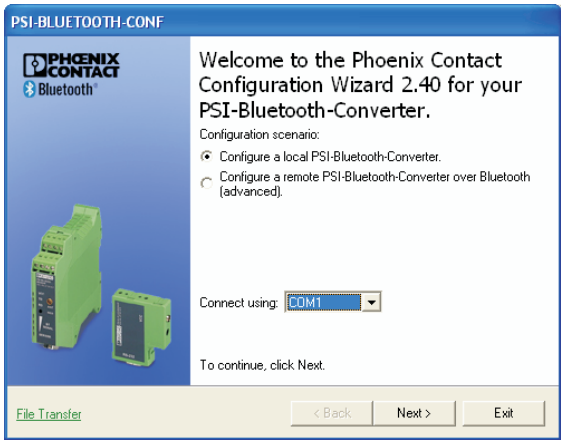
A 4.4 Setting the Bluetooth client (second Bluetooth converter)

- Connect the second Bluetooth converter and the PC via a serial 1:1 cable and supply it with 24 V DC.
- Open the Bluetooth converter housing and switch the CONF/RUN switch to CONF mode.
- Start the PSI-BLUETOOTH-CONF configuration software on the PC. Select the communication interface (e.g., COM1) and confirm with "Next".



The basic menu of the configuration wizard opens.

- Select "Serial settings" and confirm with "Next".

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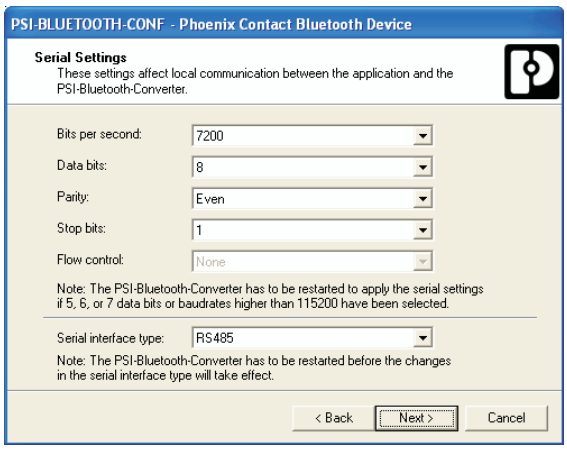
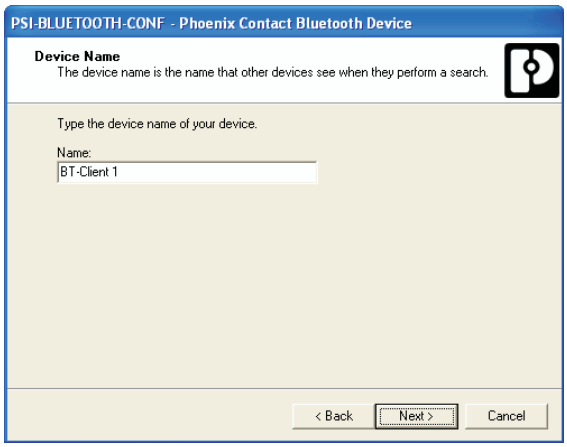

PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Serial Settings
These settings affect local communication between the application and the PSI-Bluetooth-Converter.
Bits per second:
7200
Data bits:
8
Parity:
Even
Stop bits:
1
Flow control:
None
Note: The PSI-Bluetooth-Converter has to be restarted to apply the serial settings if 5, 6, or 7 data bits or baudrates higher than 115200 have been selected.
Serial interface type:
RS485
Note: The PSI-Bluetooth-Converter has to be restarted before the changes in the serial interface type will take effect.
< Back
Next >
Cancel

- Set the parameters specified for the serial interface and confirm with "Next".
  - Transmission speed: 7200 bps
  - Data bits: 8
  - Parity: Even
  - Stop bits: 1
  - Serial interface: RS485

- Select "Bluetooth general settings" in the basic menu and confirm with "Next".


PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Device Name
The device name is the name that other devices see when they perform a search.
Type the device name of your device.
Name:
BT-Client 1
< Back
Next >
Cancel

- Enter a Bluetooth device name and confirm with "Next".

The name must be unique for every Bluetooth converter and should refer to the technological unit.

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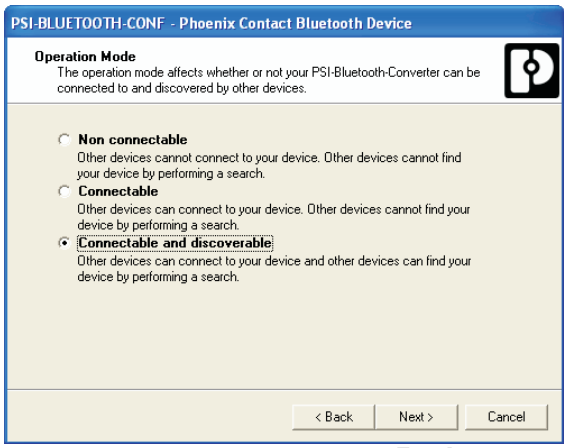
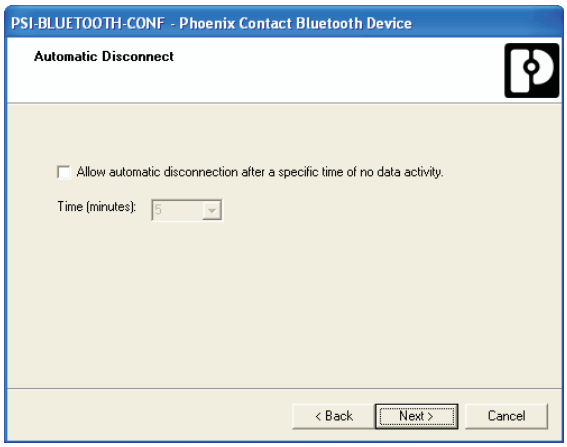
PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Security Settings
Authentication and encryption is used to prevent un-authorized access to your device and the data sent during communication.
Bluetooth security enabled
In this security mode devices are required to pair with the remote device, before being able to communicate.
Bluetooth security disabled
In this mode devices are not required to pair with the remote device, communication will be able without pairing.
Password:
4711
To activate auto pairing:
Use the same password for local and remote device.
It is recommended to use the security mode for at least one device.
< Back
Next >
Cancel

- Select the "Bluetooth security enabled" option, enter the password of the Bluetooth servers (e.g., 4711), and confirm with "Next".


PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Operation Mode
The operation mode affects whether or not your PSI-Bluetooth-Converter can be connected to and discovered by other devices.
Non connectable
Other devices cannot connect to your device. Other devices cannot find your device by performing a search.
Connectable
Other devices can connect to your device. Other devices cannot find your device by performing a search.
Connectable and discoverable
Other devices can connect to your device and other devices can find your device by performing a search.
< Back
Next >
Cancel

- To keep the Bluetooth converter discoverable and connectable, select the "Connectable and discoverable" option and confirm with "Next".



- In the "Automatic Disconnect" window disable the "Allow automatic disconnection" option and confirm with "Next".

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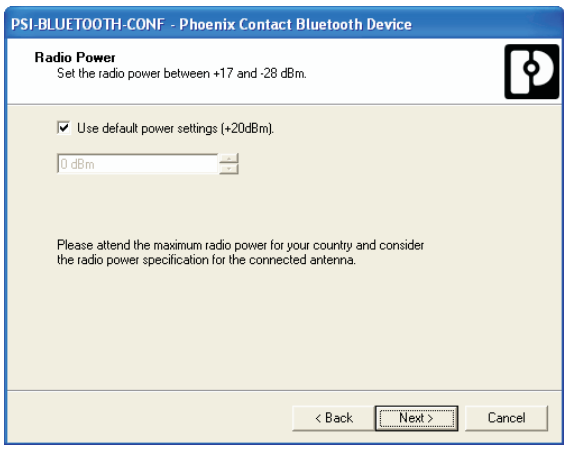
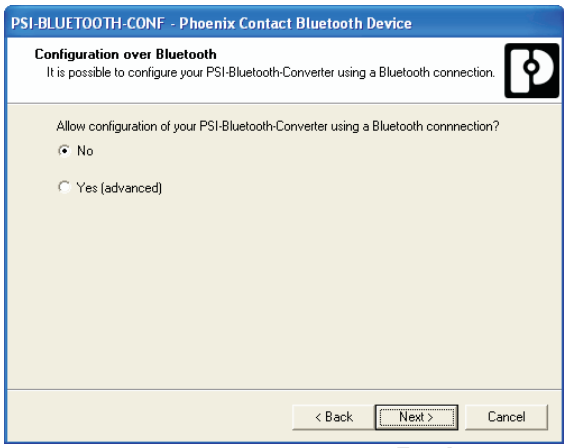
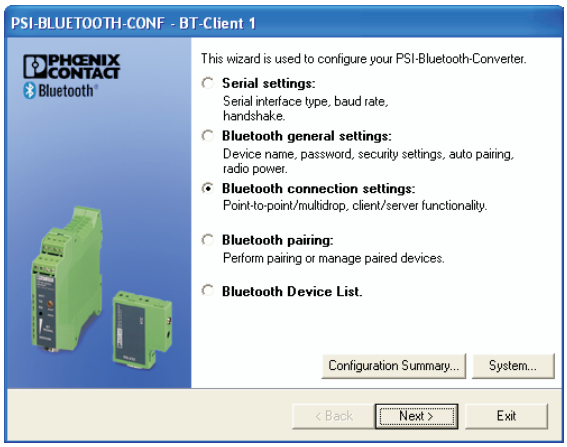

PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Radio Power
Set the radio power between +17 and -28 dBm.
Use default power settings (+20dBm).
0 dBm
Please attend the maximum radio power for your country and consider the radio power specification for the connected antenna.
< Back
Next >
Cancel

- In the "Radio Power" window select the "Use default power settings" option and confirm with "Next".


PSI-BLUETOOTH-CONF - Phoenix Contact Bluetooth Device
Configuration over Bluetooth
It is possible to configure your PSI-Bluetooth-Converter using a Bluetooth connection.
Allow configuration of your PSI-Bluetooth-Converter using a Bluetooth connnection?
No
Yes (advanced)
< Back
Next >
Cancel

- In the "Configuration over Bluetooth" window select the "No" option, confirm with "Next", and store the settings with "Save".



- Select "Bluetooth connection settings" in the basic menu and confirm with "Next".

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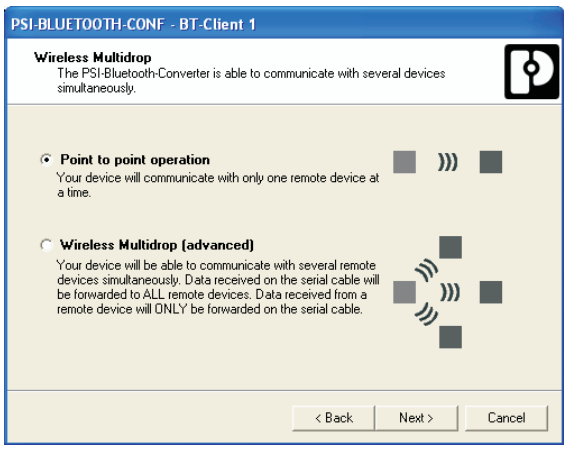
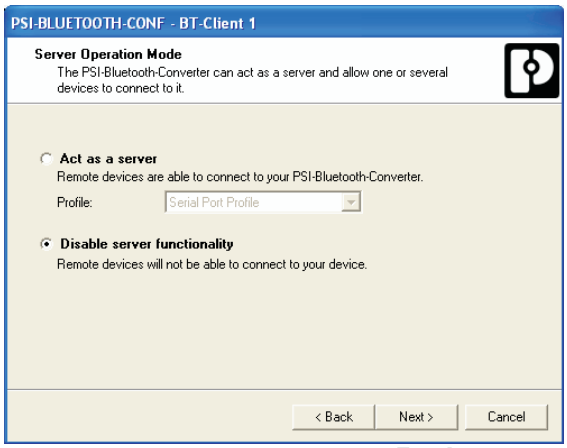
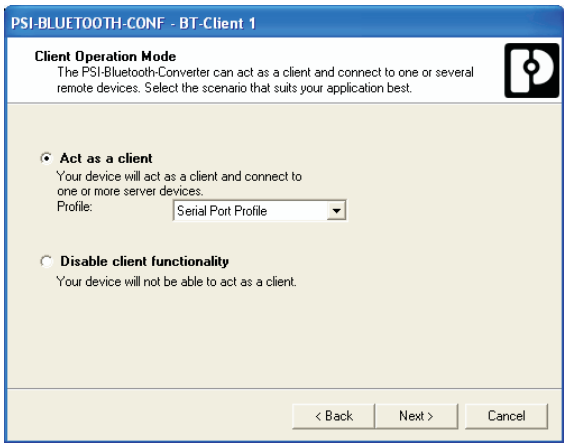

PSI-BLUETOOTH-CONF - BT-Client 1
Wireless Multidrop
The PSI-Bluetooth-Converter is able to communicate with several devices simultaneously.
Point to point operation
Your device will communicate with only one remote device at a time.
Wireless Multidrop (advanced)
Your device will be able to communicate with several remote devices simultaneously. Data received on the serial cable will be forwarded to ALL remote devices. Data received from a remote device will ONLY be forwarded on the serial cable.
< Back
Next >
Cancel

- In the "Wireless Multidrop" window select the "Point to point operation" option and confirm with "Next".


PSI-BLUETOOTH-CONF - BT-Client 1
Server Operation Mode
The PSI-Bluetooth-Converter can act as a server and allow one or several devices to connect to it.
Act as a server
Remote devices are able to connect to your PSI-Bluetooth-Converter.
Profile:
Serial Port Profile
Disable server functionality
Remote devices will not be able to connect to your device.
< Back
Next >
Cancel

- In the "Server Operation Mode" window select the "Disable server functionality" option and confirm with "Next".


PSI-BLUETOOTH-CONF - BT-Client 1
Client Operation Mode
The PSI-Bluetooth-Converter can act as a client and connect to one or several remote devices. Select the scenario that suits your application best.
Act as a client
Your device will act as a client and connect to one or more server devices.
Profile:
Serial Port Profile
Disable client functionality
Your device will not be able to act as a client.
< Back
Next >
Cancel

- In the "Client Operation Mode" window select the "Act as a client" option and the "Serial Port Profile", then confirm with "Next".

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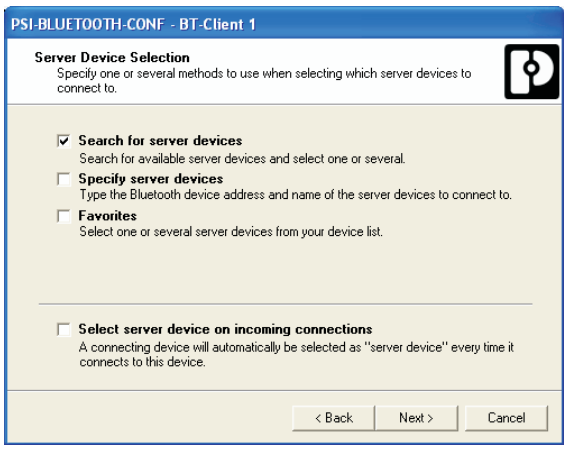
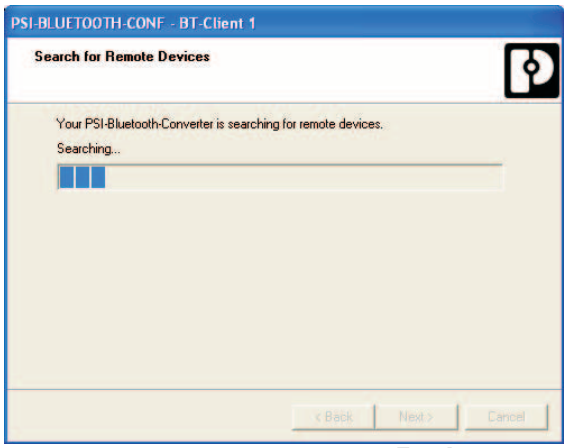
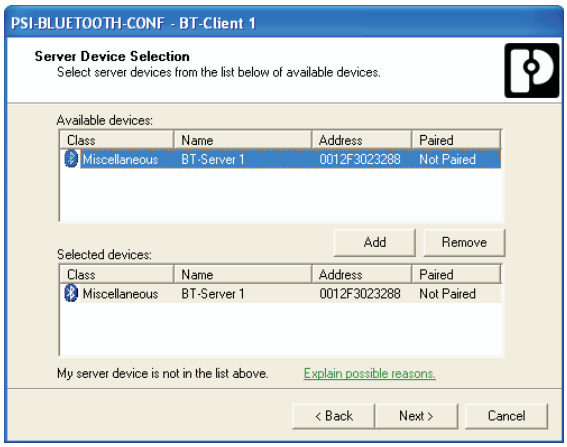

PSI-BLUETOOTH-CONF - BT-Client 1
Server Device Selection
Specify one or several methods to use when selecting which server devices to connect to.
Search for server devices
Search for available server devices and select one or several.
Specify server devices
Type the Bluetooth device address and name of the server devices to connect to.
Favorites
Select one or several server devices from your device list.
Select server device on incoming connections
A connecting device will automatically be selected as "server device" every time it connects to this device.
< Back
Next >
Cancel

- Now the Bluetooth client must search for its Bluetooth server. Make sure that the server is switched on. In the "Server Device Selection" window select the "Search for server devices" option.



- Confirm with "Next". The search for communication partners is thus started.



- Select the previously configured Bluetooth server from the "Available devices" list, transfer it with "Add" to the "Selected devices" list and confirm with "Next".

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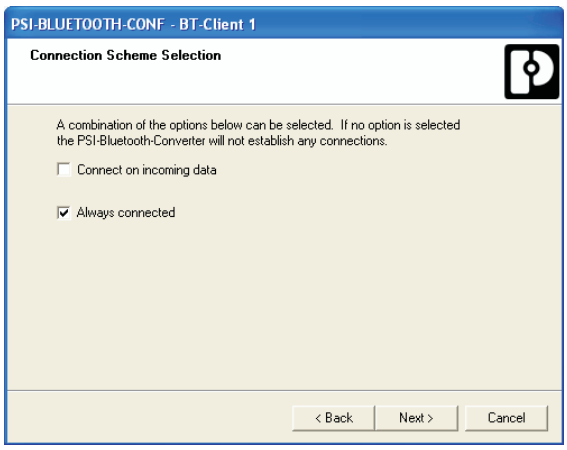
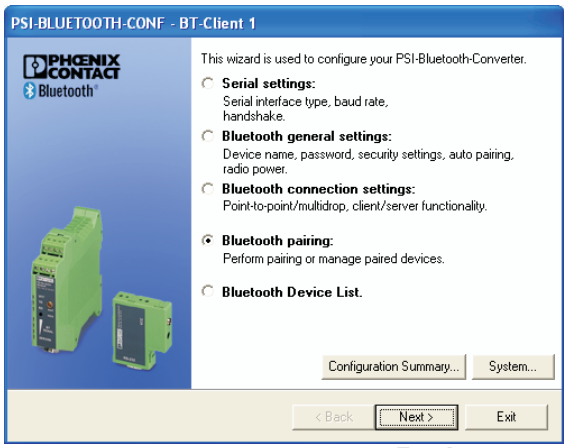
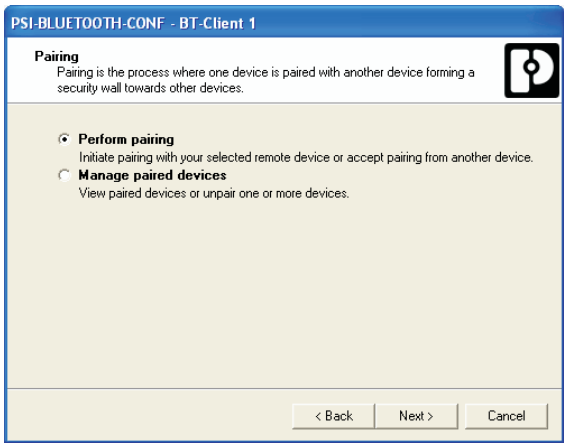

PSI-BLUETOOTH-CONF - BT-Client 1
Connection Scheme Selection
A combination of the options below can be selected. If no option is selected the PSI-Bluetooth-Converter will not establish any connections.
Connect on incoming data
Always connected
< Back
Next >
Cancel

- The Bluetooth converters are to re-establish an interrupted connection automatically. In the "Connection Scheme Selection" window select the "Always connected" option, confirm with "Next", and store the settings with "Save".



- Select "Bluetooth pairing" in the basic menu and confirm with "Next".


PSI-BLUETOOTH-CONF - BT-Client 1
Pairing
Pairing is the process where one device is paired with another device forming a security wall towards other devices.
Perform pairing
Initiate pairing with your selected remote device or accept pairing from another device.
Manage paired devices
View paired devices or unpair one or more devices.
< Back
Next >
Cancel

- In the "Pairing" window select the "Perform pairing" option and confirm with "Next".

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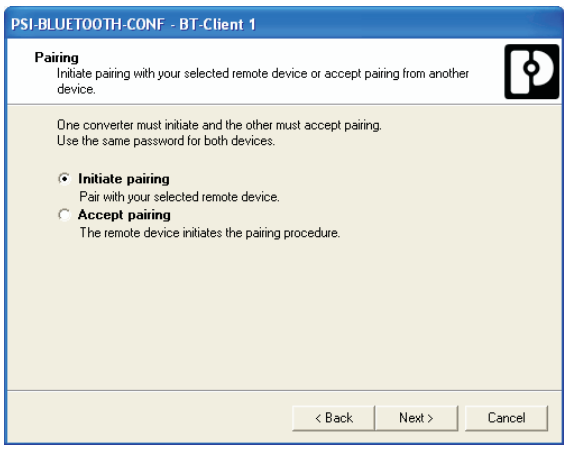
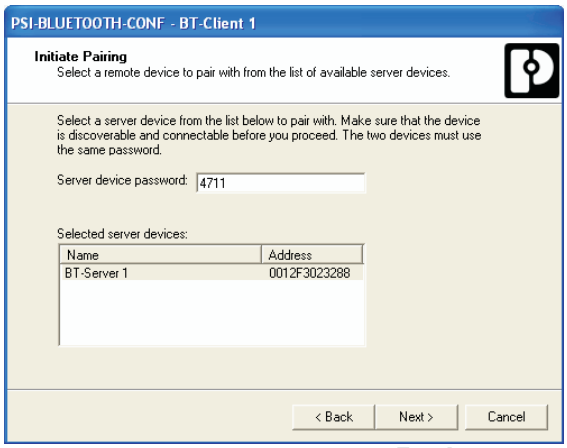
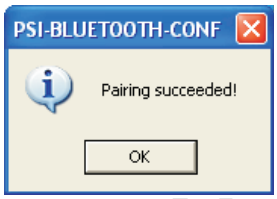

PSI-BLUETOOTH-CONF - BT-Client 1
Pairing
Initiate pairing with your selected remote device or accept pairing from another device.
One converter must initiate and the other must accept pairing.
Use the same password for both devices.
Initiate pairing
Pair with your selected remote device.
Accept pairing
The remote device initiates the pairing procedure.
< Back
Next >
Cancel

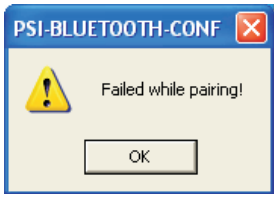
- In the "Pairing" window select the "Initiate pairing" option and confirm with "Next".


PSI-BLUETOOTH-CONF - BT-Client 1
Initiate Pairing
Select a remote device to pair with from the list of available server devices.
Select a server device from the list below to pair with. Make sure that the device is discoverable and connectable before you proceed. The two devices must use the same password.
Server device password:
4711
Selected server devices:
Name
Address
BT-Server 1
0012F3023288
< Back
Next >
Cancel

- Check the entries, confirm with "Next", and store with "Save".



- When the pairing of the Bluetooth converters was successful, the "Pairing succeeded" message appears. Confirm this message with "OK".



- When the pairing was not successful, the "Failed while pairing" message appears. Confirm this message with "OK". Check the antennas, the Bluetooth server function, as well as the password used and repeat the configuration starting with the step "Bluetooth connection settings".

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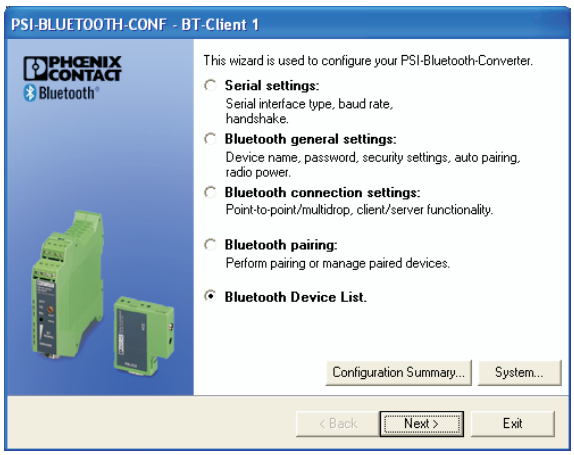

- The Bluetooth client is now configured. Close the configuration software with "Exit".

- Switch the CONF/RUN switch in the device back to RUN mode. Close the Bluetooth converter.
- Remove the serial 1:1 cable from the second Bluetooth converter.
- Restart the Bluetooth converter (24 V OFF/ON).

The two Bluetooth converters now establish the connection automatically.

Further information on the configuration and connection of interface converters can be found in the associated documentation.

A 4.5 Setting the switch on the Bluetooth converter

- Activate the bus termination by switching the "Terminate" slide switch on every Bluetooth converter to the ON position.

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A 4.6 Connecting the cables

- Assemble the adapter cable for the connection between field multiplexer and interface converter. For the terminal point assignment, please refer to Table A-13.

NOTE: Malfunction
Please make sure that the cable is not longer than 1 m.

NOTE: Malfunction
If you are using the IB IL MUX-CAB PSI (Order No. 2878476) adapter cable:
Swap the yellow and green wires at terminal points 16 and 17 of the Bluetooth converter and remove the jumper (brown) from terminal 1.1 to 2.1. of the field multiplexer connector.

Table A-13 Connection between converter and field multiplexer

Converter PSI-WL-RS232-RS485/BT		Field multiplexer IB IL MUX MA-PAC		
Signal	**Terminal point**	**Connector 1, Terminal point**	**Signal**	**Color**
Shield	10	1.4 / 2.4	Shield	–
GND	11	1.3	GND	Gray
Data + (B)	17	1.2	Data	Yellow
Data - (A)	16	2.2	/Data	Green

- Connect each field multiplexer with one Bluetooth converter.

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A 5 Transmission over Ethernet (COM SERVER)

This section describes the configuration of an Inline field multiplexer station with an Ethernet network path using two Ethernet converters FL COM SERVER RS485.

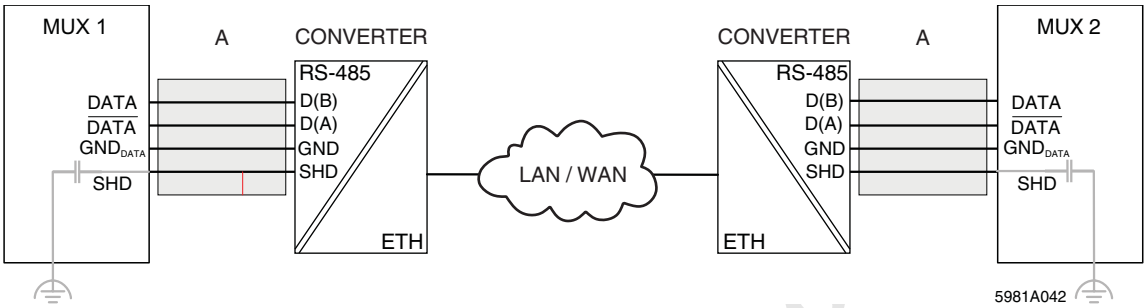

Figure A-6 Basic circuit diagram: Transmission over Ethernet

Key:

MUX	IB IL MUX MA-PAC
A	Adapter cable
CONVERTER	Ethernet converter For example, Phoenix Contact: FL COM SERVER RS485
LAN/WAN	Ethernet connection

NOTE: Malfunction

In combination with the FL COM SERVER RS485 converter, **a maximum of four analog signals** can be transmitted.

A 5.1 Devices for the field multiplexer station

Table A-14 Devices and software that can be used

Type	Type	Order No.	Number
Field multiplexer	IB IL MUX MA-PAC	2861205	2
Ethernet converter	FL COM SERVER RS485 Firmware V1.89 or later	2708740	2

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A 5.2 Basic field multiplexer settings

- Configure one field multiplexer station as master and the other one as slave (see Section "Configuring the station as a master or a slave" on page 4-8).

No jumper must be installed from 1.1 to 2.1 ($CONF_{FO}$) on connector 1 of both field multiplexers.

You will find the additional terminal point assignment of the field multiplexer in Section "Terminal point assignment" on page 4-4.

A 5.3 Checking the firmware of the FL COM SERVER RS485

A firmware V1.89 or later is required to allow the FL COM SERVER RS485 to transmit the communication protocol of the field multiplexer stations.

- To check the firmware version, open your web browser and enter the address of the FL COM SERVER RS485 (default 192.168.0.254). Then click "Device Information".

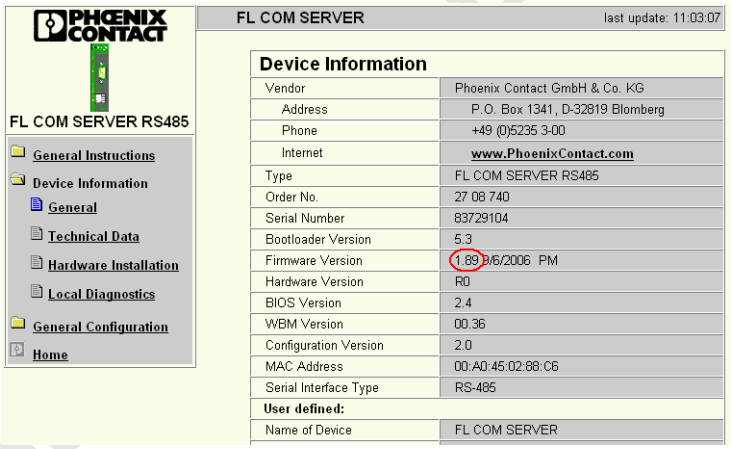

Figure A-7 FL COM SERVER RS485 firmware version

- If a firmware version earlier than V1.89 is installed, update the firmware before you proceed with the configuration.

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A 5.4 Setting the Ethernet converters using software or Web-Based Management (WBM)

Assign fixed IP addresses for both FL COM SERVER RS485:

- Click "General Configuration".
- Enter the password (default password: private) and confirm the entry by clicking "Enter".
- Select "IP" and enter the IP parameters.

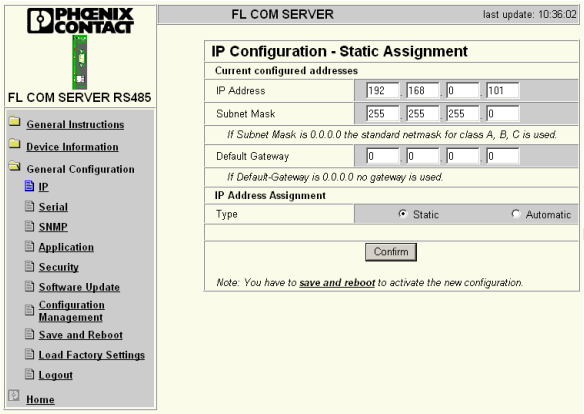

Figure A-8 Assigning IP addresses

- Confirm the modification of the configuration with "Confirm".

Proceed in the same way for both FL COM SERVER RS485:

- Set the parameters of the serial interface.
  Click on "Serial" and set the parameters specified below.
  - Transmission speed: 7000 bps
  - Data bits: 8
  - Parity: Even
  - Stop bits: 1

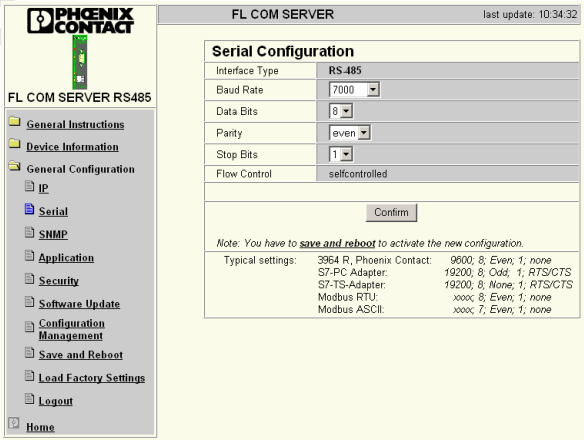

Figure A-9 Assigning IP addresses

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- Confirm the modification of the configuration with "Confirm".
- Set the FL COM SERVER RS485 in the "Application" menu to "UDP" operation mode and make the following settings:
  - Own UDP Port: Own UDP Port, default 3001
  - Remote UDP Port: Remote UDP Port, default 3001
  - Remote IP address: Remote IP address
  - Device type: Client
  - Idle Force Timeout Characters: 1

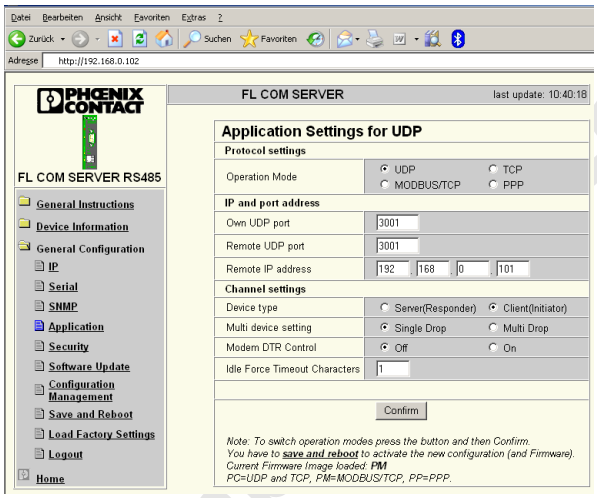

Figure A-10 UDP settings of COM SERVER 1

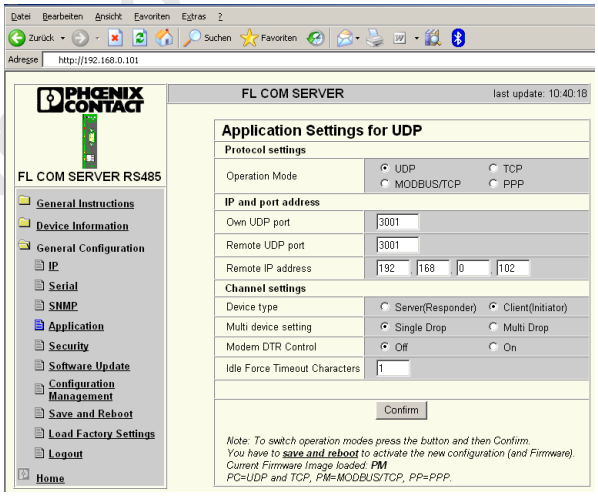

Figure A-11 UDP settings of COM SERVER 2

- Confirm the modification of the configuration with "Confirm".

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Proceed as follows to store the configuration in the FL COM SERVER RS485 and to take it over with a restart:

- Open the "Save and Reboot" menu item.
- Activate the "Save" and "Reboot" options.
- Enter the password (default password: private) and confirm the entry by clicking "Confirm".

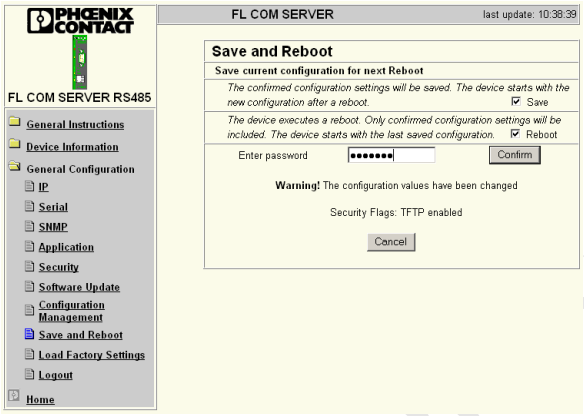

Figure A-12 Save the settings and reboot the FL COM SERVER RS485

- Confirm your settings with "Confirm".

The FL COM SERVER RS485 restarts with the saved configuration.

A 5.5 Setting the switch on the Ethernet converter

- Activate the termination resistor on the interface converter (position ON).

Further information on the configuration and connection of interface converters can be found in the associated documentation.

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A 5.6 Connecting the cables

- Assemble the adapter cable for the connection between field multiplexer and interface converter. For the terminal point assignment, please refer to Table A-15.

NOTE: Malfunction
Please make sure that the cable is not longer than 1 m.

Table A-15 Connection between converter and field multiplexer

Converter FL COM SERVER RS485		Field multiplexer IB IL MUX MA-PAC		
Signal	**SUB-D, PIN**	**Connector 1, Terminal point**	**Signal**	**Color**
Shield		1.4 / 2.4	Shield	–
GND		1.3	GND	Gray
Data P (B)	3	1.2	Data	Yellow
Data N (A)	8	2.2	/Data	Green

- Connect each field multiplexer with one Ethernet converter.

A 5.7 Example configuration

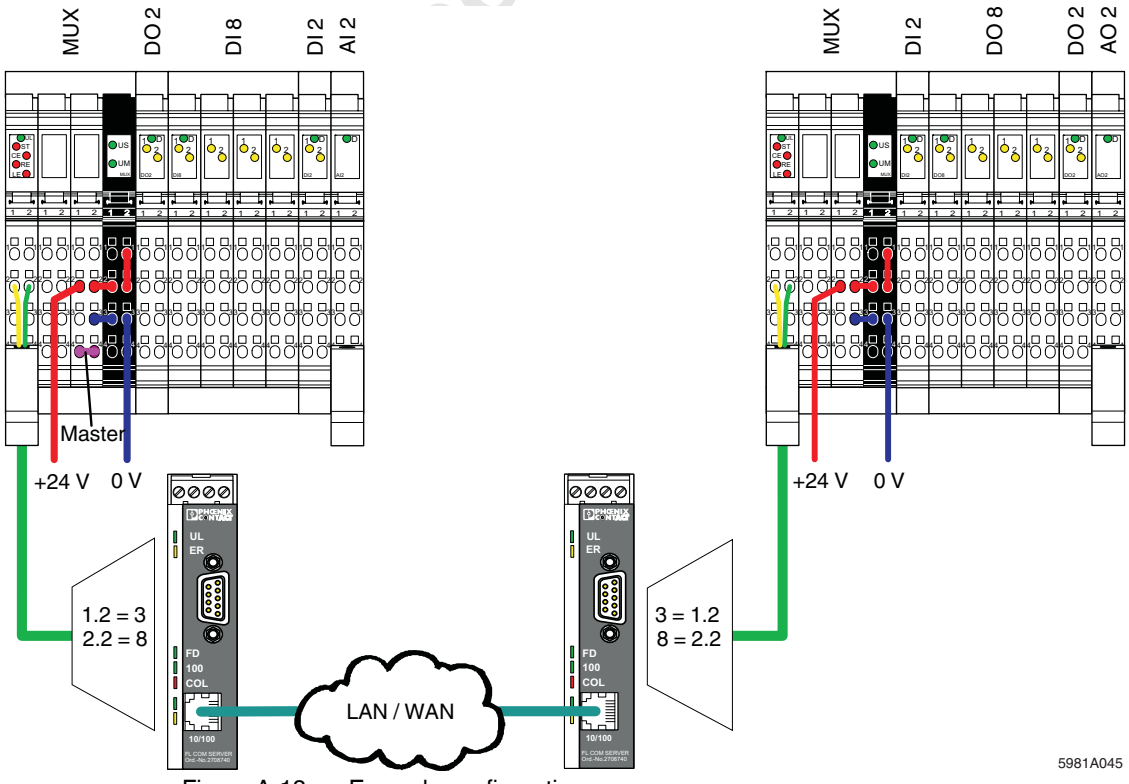

Figure A-13 Example configuration

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